# ENGINEERING NEWS.

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GEO. H. FROST, PROPRIETOR.

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We publish elsewhere the evidence of the well-known Brooklyn Civil Engineer, S. McElroy, on the superior advantages of underground railways over that of elevated ones. Mr. John Walter, proprietor of the London *Times*, recently said in a conversation with a *Sunday Press* representative: "New York is a fine city. It is admirably built. Its elevated roads are a great convenience, in my estimation. They have helped to increase the value of property uptown amazingly."

"Of course you know that great dissatisfaction has been felt with the roads throughout the City?"

"Oh, yes, that is true, but then there are always two sides to a question. I have heard just as many speak favorably of them as unfavorably."

"Do you think they serve the public as well as the underground railroads of London?"

"To a far greater extent. In the first place, you have better air, better light, and better service, and, in the second, the uniform cheap tariff demanded makes them vastly superior to the London system. On the underground roads at home the fares vary as much as on those above ground. Of course, each system has its merits and defects, but give me yours as a permanency."

## THE PROPOSED SIMPLON TUNNEL.

THERE is every probability at present that commercial and strategic reasons will induce the French government to give every encouragement to the proposed plan of tunneling the Simplon. Transportation lines follow certain routes, which are determined by natural laws and advantages. The Simplon route would bring in some English and even some Belgian trade for Italy and the Orient, while the St. Gothard will serve to develop German trade. The engineering difficulties are, however, very serious, but according to some engineers not more than those encountered in piercing St. Gothard and Mont Cenis. The Simplon is characterized by its feeble thickness as compared to its base, and this would allow of the mass being cut at the level of the valley of the Rhone, and at an altitude of 500 or 600 meters less than that of Mont Cenis, and at 406 meters lower than the St. Gothard tunnel. The distance from plain to plain would be 38 kilometers, but the whole range of the Alps would be passed in an hour, while it takes over five hours to get clear of the mountains by the other routes. The gradients on these lines, and the consequent traction power which is requisite will, it is claimed, make them unable to compete for freight with a line which runs on a plain. The real distance by rail between Paris and Milan are: By Mont Cenis, 951 kilometers; by St. Gothard, 927 kilometers; by Simplon, 850 kilometers. But, taking into account the gradients, the virtual distances are: 1,086, 1,062 and 965 kilometers respectively. There is such competition between Havre and Antwerp that the project will likely form one of the means by which the endangered position of the French port may be averted.

## IMPURITIES IN ICE.

Rain in passing through the atmosphere absorbs certain gases and mechanically carries with it minute particles of matter which are suspended in the air. In the open country it will bring with it oxygen, carbonic acid, nitrogen and nitric acid—the latter being formed by the action of electricity during a thunder storm upon the ammonia and water vapor. Although these substances are in very small quantities, which vary according to the character of the surrounding country and the exhalations arising from it, they are still present in quantities sufficient to make no doubt of their identity.

In large manufacturing towns and densely populated cities, the impurities of the atmosphere, and the consequent change in the rain water, are increased in number and volume according to the particular industries pursued and the local advantages for dispersion and absorption.

Consequently, the nearest approach we can find to perfectly pure water is in the clouds when first collected, and in deep strata, where filtration and absorption, or chemical affinity, have removed the impurities.

Humber, in his treatise on Water Supply of Cities and Towns, states that "The noxious part of sewage is that which is held in mechanical suspension, and these globules are beyond the reach of the chemist, and, to a certain extent, of the microscopist. There are only two processes by which it can be effectually removed; the one is by boiling for a long time, and the other is by distillation, both impracticable on a large scale." Further on, the same writer remarks: "It is very difficult to get rid of sewage matter by running water; that portion of it which remains undecomposed after its passage through the sewers oxidizes with extreme slowness."

Although this opening may, at the first glance, seem *mal apropos* to the subject under consideration, yet it is essential as showing the sources from which water derives its first touch of impurity and which are beyond our control, and as showing the final and real contamination it receives from sources which we can control. When water receives any matter which will decompose and produce noxious compounds, it is then that its use induces disease, and when its precise character demands an examination.

The ancients recognized this principle and in choosing a source from which to obtain a water supply looked closely for any possible impurity, and until it reached its destination the water was kept as free from injurious ingredients as possible. At the present time we bring to our aid the sciences of chemistry and microscopy in order to determine the amount of foreign matter and its specific character in any sample of water. Countless have been the analyses made of the drinking waters of the civilized world; no water-works but can show a record of the labors of the chemist; no community contemplates the introduction of water from a particular locality without first testing its purity, and it is according to the results obtained that the water is valued.

To please the appetite, principally, and add to the general comfort of the human race, ice is harvested in winter and kept that it may cool the parched tongue of weary sojourners during the heats of summer, and assist in relieving our hearts of thoughts relating to climes which do not freeze over and of which we vaguely wonder if the heat be so intense as that we are passing through. The necessity of having a supply of ice has increased rapidly during the past few years, until we now find a large proportion of our farmers building ice-houses on the edge of some small pond, in sizes varying according to their needs.

When it is remembered that ice finds its way into every household; that its properties make it invaluable in the sick-room; that the culinary department would be crippled without it; in short, that it is taken into our systems—young and old, healthy and unhealthy—in vast quantities, we then appreciate the vital importance of obtaining it free from any deleterious ingredient. Recognizing this fact, we are surprised when we find so few statistics bearing upon the subject and those few so unsatisfactory. Although we have diligently searched the libraries, we have only found stray allusions to the point of inquiry; we have read works upon potable waters and the impurities of waters, and have closed them without finding an item upon the question we were trying to solve.

Notwithstanding all that science has done it is still the popular belief that ice is free from impurities, no matter from what source it may have been derived. It is supposed that although the water of a pond or lake may be unfit for drinking yet the ice cut from it has been freed from all impurities, first by the cold atmosphere and second by the process of freezing. It is also firmly believed that decomposition ceases in winter, and that consequently the most injurious of water's contaminators is inactive. We now come to the consideration of the question:

Is water freed from impurities by being frozen?

Fanning, in his treatise of "Water Supply Engineering," makes the following statement: "Ice is now so generally used in drinking water in summer, to cool it immediately before drinking, that the people should be warned against such use of ice gathered from water that would have been unfit for drinking before freezing. Chemistry has fully demonstrated that ice is not entirely purified by the process of crystallization, as has been popularly believed."

In the above quotation we think the statement that "people should be warned against such use of ice gathered from water that would have been unfit for drinking before freezing" too sweeping in its character, although perfectly applicable in most cases. The quantity of impurities in ice—both organic and inorganic—as compared with those in the water, is dependent, to a large extent, upon certain physical conditions. The degree of cold and the resulting rate of congelation would alter the amount of organic and inorganic impurities which the ice would contain. In most small ponds a low temperature with a rapid congelation would give results containing more of the soluble salts and less of vegetable matter in suspension than would a higher temperature. A slow rate of freezing would give more time for the accumulation or entanglement in the forming ice of the products of the decomposition going on at the bottom and of the foreign matters passing with the current.

Mr. Fanning ably sums up the subject by the statement that "The process of purification of the water that would have gone on by the oxidation of the impurities is checked when they are surrounded by the ice crystals, and proceeds again when the ice melts."

Analyses of impure water and ice, taken from the same locality and as nearly as possible under the same conditions, are very rare, and we have found only a few. The most exhaustive article on this subject we came across was that written by W. R. Nichols, M. D., of Boston, on an "Outbreak of Intestinal Disorder, Attributable to the Contamination of Drinking-Water by Means of Impure Ice," and published in the seventh annual report of the State Board of Health of Massachusetts. During the season of 1875, the guests of one of the hotels at Rye Beach, New Hampshire, were taken sick, the digestive system being disturbed, as characterized by a sensation of giddiness and nausea, vomit-

ing, diarrhœa, severe abdominal pain, all accompanied by fever, loss of appetite, continued indigestion and mental depression. The trouble was confined to the guests of one hotel; those in the cottages and another hotel a short distance away being unaffected. A searching examination was made of the drinking-water, the sanitary arrangements, the culinary apparatus, and even of the various ingredients of the food, but no trace could be found of anything to which the sickness could be attributed. It was not until this time that suspicion became directed toward the ice used in the house. A large portion of this was taken from shallow ponds, which were formed during the winter by flooding the meadows, and which contained more or less vegetable matter.

The pond was of irregular outlines, about two-thirds of a mile long, and from 200 to 800 feet wide, with an average depth of about two feet. The only sources of supply were some springs said to be in the upper end and a small brook, entering the lower end, which brought down all the sawdust from two neighboring saw-mills. A space directly in front of the mouth of the brook, and about 500 feet long, by 150 wide, was filled with a mass of putrescent matter, composed of marsh mud and sawdust. The water of the pond was practically stagnant, as an artificial channel, which led from the pond to the ocean, had become filled with sand and stone, thrown up by the violent action of the sea, and only the small quantity percolating this bank escaped. Here it was that the foul matter was generated, and, impregnating the water immediately adjacent, was distributed by the currents and winds to every part of the pond, and in sufficient quantities to render the water extremely dangerous to health.

A small quantity of this ice, after having been cleansed of its surface impurities, was melted and the water thus obtained sent to Prof. W. R. Nichols, who made the following report:

"The water contains in suspension a considerable quantity of vegetable matter more or less decayed, and possesses a slightly disagreeable odor, which becomes more evident if the water is warmed. Of the organic matter which is suspended in the water, and which may be removed by filtration, a portion, consisting of the larger and heavier particles, settles somewhat readily. Another portion, being more finely divided, remains for an indefinite time diffused through the water, and would be drunk by any one using the ice in the ordinary way. I do not think it unreasonable to suppose that the presence of this decaying organic matter may have been instrumental in bringing about the unpleasant results you have observed."

The following table gives the result of an analysis of ice from the infected ponds:

| Component Parts. | Ice taken from contaminated pond at Rye Beach.* | | | |
|---|---|---|---|---|
| | Results expressed in parts per 100,000. | | Results expressed in grains to U.S.gal. | |
| | Unfiltered | Filtered. | Unfiltered | Filtered |
| Ammonia | 0.0208 | 0.0213 | 0.0121 | 0.0124 |
| Albuminoid ammonia | 0.0704 | 0.0165 | 0.0410 | 0.0096 |
| Inorganic matter | 7.80 | 6.88 | 4.55 | 4.01 |
| Organic and volatile matter | 5.72 | 2.84 | 3.33 | 1.66 |
| Total solid residue 212° Fahrenheit | 13.52 | 9.72 | 7.88 | 5.67 |
| Chlorine | .... | 3.23 | ..... | 1.88 |
| Oxygen required to oxidize organic matter | ..... | 0.334 | ..... | 0.495 |

* Small amount of nitrates.

Dr. Nichols describes his manner of taking a small quantity of water for analysis as follows: "A sample of water was likewise taken for examination from the pond in question. This sample was obtained from the central portion of the pond, in the early morning, when no air was stirring, and the water being quite calm and undisturbed, the greater portion of any matter held in suspension would at that time be precipitated to the bottom of the pond. Consequently the sample taken would represent the purest water obtainable from the pond under any circumstances."

| Component Parts. | Water taken from Pond at Rye Beach* | |
|---|---|---|
| | Results expressed in parts per 100,000 | Results expressed in grain to U. S. gallon. |
| Ammonia | 0.0197 | 0.0115 |
| Albuminoid ammonia | 0.0597 | 0.0348 |
| Inorganic matter | 64.96 | 37.88 |
| Organic and volatile matter | 8.00 | 4.66 |
| Total solid residue at 212° Fah. | 72.96 | 42.54 |
| Chlorine | 34.00 | 19.83 |
| Equivalent to chloride of sodium | 56.03 | 32.68 |
| Oxygen required to oxidize organic matter | 1.28 | 0.75 |

* Residue blackens strongly when heated. Evidently a large amount of organic matter.

In examining these tables (under the supposition that the water of the test and that which was frozen were of the same quality) we find the quantities of both free and albuminoid ammonia in both cases to be very nearly alike. Congelation reduced the amount of inorganic matter 88 per cent., while the organic and volatile matter was reduced 28 per cent. and the chlorine 90 per cent.

The report closes with the following remark: "The notion that ice purifies itself by the process of freezing is not based upon trustworthy scientific observation. On the contrary, it is utterly wrong in principle to take ice for consumption from any pond the water of which is so fouled as to be unfit for drinking purposes."

In the tenth annual report of the same board of health is an analysis of ice and water taken from Fresh Pond, Spy Pond and Little Spy Pond, by Prof. S. P. Sharples. In collecting samples the surface of the ice was first cleared away, when a sufficient quantity was chopped out with an axe, broken into small pieces, placed in a wide mouthed bottle and kept securely corked until melted. To obtain the water a hole was broken in the ice and the water dipped out and placed in a demijohn. As this mode of obtaining samples is the best that can be pursued under similar condition we present a table of results:

Results given in parts per 100,000.

| Jan. 11, '78. | Ammonia. | | | Solid Residue. | | |
|---|---|---|---|---|---|---|
| | Free. | Alb. | Total. | Volatile. | Fixed. | Total. |
| Fresh Pond water | .0128 | .0192 | .0320 | 3.00 | 9.00 | 12.00 |
| Fresh Pond ice | .0060 | .0075 | .0135 | 1.50 | 3.50 | 5.00 |
| Spy Pond water | .0640 | .0128 | .0768 | 4.00 | 13.00 | 17.00 |
| Spy Pond ice | .0064 | .0064 | .0128 | 1.50 | 3.50 | 5.00 |
| Little Spy Pond water | .0160 | .0226 | .0386 | 4.00 | 7.00 | 11.00 |
| Little Spy Pond ice | .0050 | .0060 | .0110 | 1.00 | 1.50 | 2.50 |
| Pond hole at slaughter-house near fresh pond water | .0352 | .1472 | .1824 | 10.00 | 7.00 | 17.00 |
| Pond hole at slaughter-house near fresh pond water | .0090 | .0060 | .0150 | 1.50 | 1.00 | 2.50 |

That ice is capable of containing impurities in sufficient quantities to spread disease we have abundant proof; yet analyses of water and of a portion of the same water frozen are what we need in order to determine the exact loss of impurities by freezing, and also to obtain the relative amounts lost by various substances.

Those who use ice and can inspect the pond from whence it came will do well to examine its condition and also that of the stream by which it is fed. If there be vaults, stables, or worst of all, hog-pens, which drain into the pond, an analysis of the ice should be made, especially if it be wide and shallow with a very slow flow. The refuse which falls into the pond and settles to the bottom should be examined, as decomposition, although much retarded by cold, still goes on, and the resulting product being carried to the surface by that vertical current which cold always induces in water, will mix with the ice, where it will lie dormant until its prison shall have been melted.

Freezing water will not free it of all animalcules, but will render a portion of them torpid until conditions favorable to their growth are presented.

It is logical to suppose that, all conditions being equal, the fouler the water the fouler the ice from it, and Humber, in his treatise on the "Water Supply of Cities and Towns," states that "the noxious part of sewage is that which is held in mechanical suspension, and these globules are beyond the reach of the chemist, and, to a certain extent, of the microscopist." He also states that "it is very difficult to get rid of sewage matter by running water; that portion of it which remains undecomposed after its passage through the sewers oxidizes with extreme slowness." This remark could be aptly applied to ponds from which we have seen ice harvested.

The sanitary engineer needs chemical analyses of water and of ice from the same water in order that he may obtain the exact percentage of purification by freezing; he also needs a microscopical examination under the same conditions, that he may form a correct judgment concerning vegetable matter in suspension and animalcules.

## PERSONAL.

Mr. James Holden, Managing Director of the Whitby, Port Perry & Lindsay Railway, Ont., died at Dominion City, Manitoba, on the 24th.

Daniel Hanvey, Sr., one of the civil engineers who surveyed and laid out the original site of St. Thomas, Ont., died in that city on the 24th.

R. B. Provoost, one of the most prominent civil engineers in the West, dropped dead at Dubuque on Saturday last. He helped to construct the Michigan Southern and Illinois Central roads.

A. B. Chandler, for the past two years President of the Atlantic and Pacific Telegraph Company, has accepted the Presidency of the Fuller Electrical Company at New York.

P. P. Wright, of Passaic, who was for many years Superintendent of Transportation on the Erie Railway, has been appointed General Superintendent of the Lake Shore & Michigan Southern Railroad.

"Give examples," says an old back number on the Board of Examiners, addressing the ensign, "of different degrees and velocities of motion." "Well," the ensign said, "the swiftest motion is that of light, and the slowest, by several hundred degrees, is promotion." They sent him back two years.

Several officers of the Milwaukee, Lake Shore and Western Railroad, including General Superintendent H. G. R. Reed and General Freight and Passenger Agent F. H. Whitcomb, have handed in their resignations to the Board of Directors to be acted upon immediately.

John Spellman, of Tiffin, O., a young civil engineer, graduate of Ohio University, received a dispatch the other day to come to the City of Mexico, and enter the employ of the Mexican National Construction Company on construction work. He has one assistant engaged and is looking for a leveler. He will leave for Mexico in a few weeks.

This is said to be a fresh one from England: Lady, anxious to reach the station—"Cahn't you drive a little fahster? We'll miss the train if you don't 'urry." Cabman whips up his 'orse, but doesn't

seem to get on much "fahster." Lady, again—"*Cahn't* you 'urry the 'orse a bit? 'It 'im in some wital part, vy don't ye?" Cabman—"'It 'im in some wital part? Vy, mum, hi've halready 'it 'im in all uv his wital parts hexcept one, and hi'm reserving that for 'Olborn 'Ill!"

Rarely has there been issued from the press a more entertaining volume than the "Explorations of the World," by Jules Verne (Scribner). This is not a collection of romances, but of facts; and, though the narratives go back no further than the beginning of the present century, they cover a period of the greatest progress ever made in geoggraphy, with the single exception of the last quarter of the fifteenth century, during which America was discovered. The book is illustrated with a great number of wood engravings.

W. C. Wetherell, Chief Engineer of the National Railway, has resigned, and William Cross is temporarily filling his place. G. Clinton Gardner, General Manager of the National, has started for the Pacific coast, and will return to New York over the proposed line of the National road to the Rio Grande. The rumor that the survey of the National from Mexico to Toluca is merely for a branch line, and that the main line will be by way of El Satto to Maravatio, is incorrect. Toluca will be on the main line as contemplated, and work beyond Tula towards Maravatio is being pushed.

THE LABOR PROBLEM OF THE SOUTH.—Near Halltown, as I rode along the highway, I saw a team in the field and the negro hired man sitting on the grass intently gazing into the top of a cherry tree.

"What are you looking at?" I asked, as I rode up to the fence.

"Do you b'long 'round yere?" he queried in reply.

"No."

"Well, den, boss, I wasn't 'zactly lookin' at anythin' up dat tree. I war simply tryin' to hurry up sundown."

Let him work with a white man and he will earn any pay given him, but the black man is bound to watch for sundown if working alone.—*Virginia Correspondence Detroit Free Press.*

## OBITUARY.

The Albany papers report the sensation caused in that city by the sudden death, on the 21st inst., of Thomas McElroy, one of the oldest and most respectable citizens. In crossing the tracks of the Saratoga railway at the cemetery, his attention was directed to the northern-bound train, so that he failed to see in time the southern-bound express. He had cleared both tracks, but was struck by the engine-bumper beam, thrown about thirty-five feet and instantly killed. Mr. McElroy was an old merchant there, succeeding his father-in-law, Samuel McElroy, in a business carried on for about seventy-seven consecutive years. He was prominently identified with the public institutions of the city; at one time a leading politician, and an officer in the old North Dutch Church for about twenty-six years. He had reached and nearly completed his eighty-third year, and was remarkably vigorous. An address delivered by him a week before his death showed no diminution of his mental powers. Mr. McElroy was the second link in a family with four generations of engineers: James McElroy, builder, under William McElroy, C. E., of the first canal locks at Wood Creek, N. Y., about 1796; of the Waterford Bridge on the Hudson; the State capitol at Albany; lake fortifications and other works. William McElroy, resident engineer on the Middle Division of the Erie Canal from 1817 to 1821. Thomas, his brother, the favorite leveler of Canvass White, C. E., who determined the most difficult problems of canal location. Samuel and Alexander McElroy, sons of Thomas, long identified with the Erie Canal, various State and other surveys, water-works, railways, etc., and William Harding McElroy, grandson of Thomas, who has recently completed one of the most difficult problems in railway location in Pennsylvania, and holds a high rank as a field engineer.

## A BONANZA IN IRON.

A rich mine—in fact a regular mountain of magnetic iron—is stated to have been discovered at Palmer, about four leagues to the northeast of Culiacan, Mexico. Ed. P. North, Chief Engineer of the railroad from Altata to Culiacan and Durango, lately invited a party to visit the mountain. That part of it containing the mineral is almost a regular cone, having an inclination of 35° to the horizon, and is calculated to contain 52,000,000 of cubic feet of the metal! Specimens of the ore have been sent to the United States. As the mountain is only seventeen leagues from the coast, and as the railroad will be prolonged to Durango, a large foreign trade is expected. We take the foregoing from *El Continental*, a paper published at Culiacan Rosales.

## THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.*

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page* 414.)

### CXXI.—MINNEAPOLIS.

Minneapolis, Minnesota, is on the Mississippi River, at the Falls of St. Anthony, which, with a descent of 50 ft. within a mile, furnish a valuable water power. The city is on a broad, elevated plain.

Settled in 1849, it was incorporated as a city in 1867, and the city of St. Anthony, on the opposite side of the river, was annexed to it in 1872.

In 1867 water-works were built by the city after the plans and under the superintendence of James Waters, C. E., taking water from the Mississippi River, and pumping it by water power directly into the mains. There were first erected one upright and one horizontal pump, designed by J. Waters, and a Holly rotary pump for fire service.

In 1880, a horizontal double-acting piston pump, built by O. A. Pray & Co., was substituted for the rotary. The pumping capacity of the whole works is estimated at 10,000,000 gallons per day. Inconvenience is experienced at times of low water in the river for want of power, and in some cases the wheels of private mills have to be attached to the city works, to aid in raising the pressure for fire purposes above 53 lbs., the ordinary domestic pressure. The works are to be enlarged, and additional pumps put in during the next year.

Distribution is by cast-iron pipes, of which, on March 31, 1881, there were in use 18 miles, with 256 fire hydrants, 1,119 taps and 20 meters. There is also about ¾ mile of wooden pipe, which is soon to be replaced by iron. A submerged main across the river connects the two portions of the city. In the spring of 1880, a flood in the river washed out the sand on which the pipe rested for 100 ft., causing the pipe to pull apart, and depriving the east side of water for six weeks. The sediment which was deposited by the water during the subsidence of the freshet buried the broken pipe under seven feet of mud. It was relaid on the bed-rock.

The population in 1880 was 46,887, and the daily consumption for the year ending March 31, 1881, was 3,010,591 gallons. In the previous year it was 2,628,569 gallons.

The total cost of the works, for construction only, exclusive of maintenance, to March 31, 1881, had been $404,237.59, and the interest paid on the bonded debt $163,365. The receipts have been as follows:

| | | | |
|---|---|---|---|
| 1872 | $2,406.82 | 1877 | $6,521.16 |
| 1873 | 2,795.00 | 1878 | 10,235.75 |
| 1874 | 3,421.90 | 1879 | 12,402.94 |
| 1875 | 4,685.27 | 1880 | 15,920.05 |
| 1876 | 3,029.05 | 1881 | 20,818.51 |

The cost of pumping in 1880-81 was $6,269.49.

The total expenses of maintenance and repairs for the year were $14,849.87. This did not include the new pump, which cost $7,638.76.

The works are managed by a superintendent, who reports to the city council. James Chalmers was superintendent in 1877. The present superintendent is W. H. Johnson.

### CXXII.—ELIZABETH.

Elizabeth, New Jersey, in lat. 40° 40′ N., long. 74° 14′ W., is on the Elizabeth River, 14 miles from New York City. Settled in 1665, it was called Elizabethtown until 1852. It was incorporated as a city in 1865. The site is flat.

In 1852 water-works were built by a private company taking water from the Elizabeth River. It is impounded in a reservoir of 200,000,000 gallons capacity, whence it passes through a sand and charcoal filter of 1,000 cubic ft. capacity to a basin holding 2,000,000 gallons, and is then pumped by two direct-acting horizontal steam pumps of 12 and 13-in. diameter and 48-in. stroke, and one pump of 20-in. bore and 48-in. stroke, driven by a turbine wheel into a distributing reservoir of 15,000,000 gallons capacity, on a small eminence in the city.

Distribution is by wrought-iron and cement pipe, of which there are 40 miles in use, with 200 fire hydrants and 20 meters. The number of taps is not furnished, nor any statement of revenue. The cost of the works was $500,000, and the annual cost of maintenance $35,000.

The population in 1880 was 28,229. The consumption is not given. The superintendent is William Whalen.

### CXXIII.—NASHUA.

Nashua, New Hampshire, is a manufacturing town, 40 miles northwest of Boston, on the west side of the Merrimack River, at the mouth of the Nashua River, which flows through the town. It was incorporated as a city in 1853. Water-works were built in 1855 by the Pennichuck Water Company, a private corporation, taking water from Pennichuck Brook, a small stream which flows from Long Pond, west of the city, with a rapid descent to the Merrimack, furnishing five water powers, all of which are owned by the company, and at three of which dams are built. No manufacturing is permitted on the stream. At the middle dam a Lang plunger pump of 1,000,000 gallons capacity, driven by two small Swain turbines, and at the lower dam a Lang pump of 3,000,000 gallons capacity, driven by a Jonval turbine, supplemented in scarcity of water by a 65 horse-power steam engine built by G. R. Rollins, raise the water 132 ft. to the distributing reservoir of 2,000,000 gallons capacity.

Distribution is by cast-iron pipes. Two mains of 16-in. and 12-in. diameter lead from the reservoir to the city, and there branching into 23 miles of pipe from 10-in. to 4-in. diameter, on which are placed 75 hydrants of various patterns. There are 1,600 taps.

The population in 1880 was 13,397, and the daily consumption 1,000,000 gallons.

The capital stock of the company was at first $135,000, since increased to $200,000. The cost of the works has been about $225,000, which has been paid out of the earnings. The annual expenses are $10,000 and the receipts $30,000. The city pays for fire and other purposes $5,700 per annum, and the company pays $3,000 for taxes.

Dr. Edward Spalding is president of the company, and H. M. Hobson treasurer and secretary.

### CXXIV.—SOUTH BEND.

South Bend, Indiana, is 85 miles east of Chicago,

* Copyright 1881.

on the west bank of the St. Joseph River, which furnishes a fine water power. The town was laid out in 1831. In 1873 water-works were built by the town after the plans of Henry P. M. Birkinbine, C. E., taking the supply from the St. Joseph River, and pumping it by three Flanders pumps driven by a turbine wheel. The capacity of this pumping machinery was 3,000,000 gallons per day.

A new pumping station was built in 1880 and improvements made in the pumps. Beneath the pump-house a reservoir has been constructed to receive water from wells sunk 65 ft. below the surface, which it is intended to construct within a few months. The water from that depth is reputed to be abundant and pure, and to rise to 5 ft. above the present pump-levels. The new works have been designed by E. L. Abbott.

The water is delivered from the pumps into a stand-pipe of plate iron 5 ft. in diameter and 204 ft. high, inclosed in a brick tower. The distribution is by 17¼ miles of Wyckoff wooden pipe and 2¼ miles of cast-iron pipe. No pipes are of less than 6-in. diameter. There are in use 185 fire hydrants, 600 taps and 25 meters.

The population in 1880 was 13,279, and the daily consumption 1,000,000 gallons.

The cost of the works has been $225,000. The expenditures in 1880 were $3,500 and the receipts $5,000.

The works are managed by three trustees elected by the people. E. L. Abbott is the superintendent.

CXXV.—GREAT BARRINGTON.

Great Barrington, Massachusetts, in lat. 42° 11′ N., long. 73° 22′ W., is on the Housatonic River in a long winding valley inclosed between rocky hills. Settled in 1730, it was incorporated as a village on June 30, 1761.

In 1868 water-works were built by a private company, taking water from a mountain stream of very soft and clear water, and supplying the town by gravity. A dam 8 ft. high and 100 ft. long forms a reservoir, at the outlet of which is constructed a stone filter filled with coarse gravel and charcoal, which works satisfactorily. The reservoir is 211 ft. above the river and about 100 ft. above the town.

Distribution is by cast-iron pipe, of which ½ mile is 6-in. and 1½ miles 4-in. cast iron, and 1 mile of 2-in. wrought iron. There are 21 fire hydrants and 225 taps. The town furnishes fire hydrants and the company supplies the water gratis. The population in 1880 was 2,341. The consumption is not given.

The works cost $20,000. The company in the first nine years paid 65 per cent. in dividends, and since then pay 6 per cent. semi-annually. John L. Dodge is president and Henry T. Robbins secretary of the company.

CXXVI.—SUSQUEHANNA.

Susquehanna, Pennsylvania, is in lat. 40° 19′ N., long. 76° 54′ W., on the Susquehanna River. The site of the town is hilly, and was settled in 1840. In 1874 water-works were built by a private company, taking water from a spring pond 60 ft. in diameter, and conveying it by a 6-in. cast-iron pipe to a distributing reservoir 30 ft. in diameter and 4½ ft. deep, built of round stones laid in cement. Distribution is by small galvanized iron pipe, of which ¾ mile is in use, with 5 hydrants and 700 taps. The population in 1880 was 4,114 and the daily consumption unknown. The works cost $6,500. The capital stock of the company is $5,000, and there is no debt. The expenses of maintenance are $55 per year, and the receipts in 1880 were $600.

Gaylord Curtis is president and C. A. Miller secretary, treasurer and manager of the company.

CXXVII.—CONCORD.

Concord, Massachusetts, is in lat. 42° 28′ N., long., 71° 20′ W., on the Concord River, 18 miles west of Boston, on undulating ground. The portion supplied with water is generally level. The town was settled in 1635.

In 1874 water-works were built by the town, after the plans and under the superintendence of William Wheeler, C. E., taking the supply from Sandy Pond, a natural lake, 225 ft. above tide level, and conducting it to the town by a 10-in. wrought-iron and cement pipe, 2½ miles long, with a fall of 100 ft.

Distribution is by 5 miles of wrought-iron and cement pipe, and about 2 miles of cast-iron pipe, which is used for extensions. There are 50 fire hydrants and 300 taps. Meters are not used.

The population in 1880 was 3,295. The consumption is not known.

The works have cost $71,000, and the annual cost of maintenance, exclusive of interest, is $700.

The receipts are not given.

The works are managed by a board of water commissioners. William Buttrick is the Superintendent.

CXXVIII.—STOCKBRIDGE.

Stockbridge, Massachusetts, is in lat. 42° 17′ N., long. 73° 20′ W., on the Housatonic River, on uneven ground. It was settled in 1718, and incorporated in 1739.

In 1860 water-works were built by a private company, taking the supply from springs and surface drainage on Bear Mountain, a mile and a half from the village, where a storage reservoir was formed by a dam of stone laid in cement, 60 ft. long and 12 ft. high, across a ravine at the base of the mountain. From a sand and gravel filter at the outlet the water is distributed by 1½ miles of 4-in. and 1 mile of 3-in. cast-iron pipe, and 1 mile of inch pipe. There are 5 fire hydrants and 95 taps.

The population in 1880 was 2,361. The consumption is not stated. The cost of the works is $9,500. The cost of maintenance in 1880 was $246, and the receipts $900.

H. J. Dunham is the secretary and manager of the company.

(TO BE CONTINUED.)

We acknowledge with thanks the receipt of the following:

From S. Van Cleve, Superintendent and Engineer, Sketch of Des Moines, Iowa, Water-works. From E. L. Abbott, Superintendent, Statistics and Water Rates of South Bend, Indiana, Water-works. From W. H. Johnson, Superintendent, Statistics, Water Rates and Report for 1881 of Minneapolis, Minnesota, Water-works. From Henry T. Robbins, Secretary, Statistics, Water Rates and History of the Great Barrington, Mass., Water Co. From H. J. Dunham, Superintendent, Statistics of Stockbridge, Mass., Water-works. From W. Whalan, Superintendent, Statistics of Elizabeth, New Jersey, Water-works. From John Gallion, Superintendent, Statistics of Lyons, Iowa, Water-works. From W. Buttrick, Superintendent, Statistics of Concord, Mass., Water-works. From H. M. Hobson, Treasurer and Secretary, Statistics of Pennichuck Water Co., Nashua, N. H. From R. N. Ellis, City Engineer, Statistics of Jacksonville, Fla., Water-works. From A. G. Beardsley, President Water Co., Statistics of Auburn, N. Y., Water-works. From C. A. Miller, Secretary of Water Co., Statistics of Susquehanna, Pa., Water-works. From D. G. Phipps, Secretary of Water Co., Statistics of New Haven Water-works, giving corrections of report on p. 372, as follows: Length of Lake Whitney, 2½ miles; capital stock of company, $125,000; bonded debt, $125; 630 hydrants and 90 meters in use. From C. E. Fowler, City Engineer, New Haven, report of special investigating committee, containing statistics of the New Haven Water Co., as follows:

| | |
|---|---|
| Amount expended on construction to July 1, 1881 | $1,096,503.31 |
| Amount of dividends declared | 622,937.50 |

The revenue and expenses (exclusive of interest) for 9 years past have been as follows:

| | Receipts from water rates. | Current expenses. |
|---|---|---|
| 1872 | $81,046 | $22,330 |
| 1873 | 89,861 | 23,729 |
| 1874 | 95,358 | 25,356 |
| 1875 | 92,744 | 40,842 |
| 1876 | 106,636 | 33,078 |
| 1877 | 114,734 | 27,508 |
| 1878 | 117,181 | 22,858 |
| 1879 | 124,147 | 23,620 |
| 1880 | 131,575 | 29,121 |

CORRECTIONS.—*Utica*, p. 425, Oct. 22. Town was founded in 1787, not 1757; population in 1881, 33,918. *Pittsfield*, p. 414, Oct. 15. For *Phineas*, read *Phinehas*.

## ENGINEERS' SOCIETIES.

### AMERICAN SOCIETY OF CIVIL ENGINEERS.

The following shows additions, changes and deaths of members since the issue of the July number of the proceedings:

*Additions.*

Members elected are:

Wm. H. Atwood, Res. Engineer New York, Lake Erie & Western R. R., Jersey City, N. J.; Robert Blickensderfer, Div. Engineer Utah & Northern Railway, Terminus, Montana; Wm A. May, box 173, Scranton, Pa.; Arthur W. Wellington, Locating Engineer Mexican National Railroad, Mexico, Mex.; Hunter Stewart, 2,828 Washington avenue, St. Louis, Mo.

*Change of Address.*

M. J. Becker, Chief Engineer P. C. & St. L. R. R., Pittsburgh, Pa.; D. P. Bruner, P. O. Box 4, Allegheny City, Pa.; E. S. Chesbrough, Dept. Public Works, 31 Chambers street, New York City, N. Y.; E. L. Corthell, Chief Engineer N. Y., W. S. & B. R. R., 20 Nassau street, New York City, N. Y.; N. W. Ellis, Box 53, Manchester, N. H.; G. Clinton Gardner, General Manager Mexican National R. R., 47 William street, New York City, N. Y.; Henry Harding, Maverick House, East Boston, Mass.; William P. Harris, Superintendent N. Y. & G. L. R. R., Jersey City, N. J.; F. H. Lehnartz (Stockder & Lehnartz), Lake City, Col.; G. Leverich, Box 174, South Orange, N. J.; Charles H. McKee, D. & H. C. Co. R. R., French Mountain, N. Y.; Louis R. McLain, Division Engineer G. & P. R. R., Oxford, Ala.; Charles Paine, General Manager N. Y., W. S. & B. R. R., 20 Nassau street, New York City, N. Y.; Robert P. Stanton, Div. Engineer U. P. R. R., Union Depot, Denver, Col.; Charles M. Harris, care Parsons & Co., 42 Pine street, New York City, N. Y.; Frederick Brooks, Mexican Central Railway, Tampico, Mex.; Edward Butts, P.O. Box L., Kansas City, Mo.; Sanford Horton, 48 Carroll street, Poughkeepsie, N. Y.; D. Jones Lucas, Corry, Pa.; Charles Ward Raymond, 269 West Eleventh street, New York City, N. Y.

DEATHS.

James H. Reno, Wm. G. Fargo.

## CORRESPONDENCE.

### EXCESS LOAD DUE TO WIND PRESSURE ON BRIDGES.

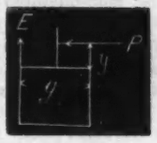
ENGINEER'S CAMP, M. N. C. R. R.,
NEAR SALISBURY, N. C., Oct. 24.

EDITOR ENGINEERING NEWS:

It seems to me that the first formula proposed by Mr. Ward, in your issue of Aug. 20, for the *excess load* due to wind pressure on the leeward truss, is more nearly correct than the one proposed by Mr. Gottlieb and afterwards indorsed by Mr. Ward.

The simplest application of the principle of moments will give this "excess load;" thus:

Let $P$ = Wind pressure per lineal foot on train.
$y$ = distance above top of floor beam to center of gravity of exposed surface of rolling load.
$E$ = Excess load on leeward truss due to wind pressure.
$g$ = distance between trusses, center to center.




then,

$$Eg = Py \therefore E = \frac{Py}{g}$$

as Mr. Ward finds on p. 336.

The weight of the rolling load ($w$ per lineal foot) does not enter the formula at all, for it is *only* the action of the wind that causes the *excess load* over the $\frac{w}{2}$ sustained by each truss, due to the weight of the train.

If we should combine $P$ with $w$, and then decompose the resultant $R'$ so formed, at the level of the top of rail, into horizontal and vertical components, and afterwards *throw away* the horizontal component in ascertaining the "excess load," as does Mr. Gottlieb in your issue of Sept. 17, p. 375, we should obtain his formula; but I cannot see how we can get rid, in this off-hand way, of this same horizontal component, which, if retained, leads again to the formula $E = \frac{Py}{g}$, just given. This component must be transferred to the floor beam through the rails, cross ties and stringers, which are regarded as immovable; its action at the level of the top of the rails must be to cause a moment about the top of floor beam in order to effect this transference. If the stringer rests on the *top* of the floor beam, friction alone is relied on to transfer this horizontal component to the top of the floor beam. If the stringer is connected by rivets to the web of the floor beam, *then y should equal distance from line of action of P to near top of connection of stringer to floor beam.*

The horizontal components acting along all the floor beams, act as an uniform horizontal load on the truss, and being resisted by horizontal bracing, in connection with the chords, is transferred to the abutments. Of course the resultant $R'$ should not pass outside the truss, or it will be overturned. If it passes outside the rails the cars will be overturned.

The excess load on rails and stringers is easily ascertained in a manner similar to the above, also the load caused by wind blowing on surface of truss only.

I am pleased to see that Mr. Gottlieb recognizes Woehler's law, which tends to diminish the factor of ignorance or safety somewhat.

Mr. Ward's proposition to diminish it in another direction is commendable.

By all means let us have the stress sheets.

Respectfully, WM. CAIN.

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## FORMULAS FOR COLUMNS AGAINST BUCKLING.

ABOUT THE AGREEMENT OF RESULTS OBTAINED FROM TESTS WITH THOSE RECEIVED FROM FORMULAS FOR SAFETY OF COLUMNS AGAINST BUCKLING.

PITTSBURGH, Pa., Oct. 13, 1881.

EDITOR ENGINEERING NEWS:

In the following I take the opportunity (induced by different discussions about the matter mentioned in the superscription, in your valuable paper as well as in others) to make an addition, and in doing so I trust to meet the desires of many of my colleagues in engineering, and would endeavor to state in the following:

1. In which relation the general practical formula

$$s = \frac{1}{n} \frac{s_1}{a\frac{l^2}{r^2} + 1}$$

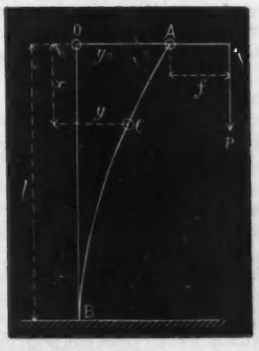
as used in calculations of the sections of columns for safety against buckling, is to the more exact formula derived direct from the deformation of post due to an eccentric stress parallel to the axis of the post, and

2. In which manner the coefficient $a$ of the above formula is to be assumed, justifying the the tests, made with any kind of materials.

According to my opinion, it is desirable to possess a formula which (if of the above mentioned form may be called after Gordon or Rankine), instead of figures attached to $\frac{l^2}{r^2}$ as coefficients, would show all those elements from which those figure coefficients have arisen, and which by any means must comprise the quality of the material in question.

In structures as well as in cases of experiments where members as posts, chords, struts, etc., are under compressive strain, we know that probably on none of them the direction of this strain will be coincident with the axes of these members, and in tests, even if this strain upon them should coincide, as long as applied but to a small extent, it will act as an eccentric force in proportion as it increases.

For this reason we choose, in discussing No. 1, the case of an eccentric force acting as shown in diagram, and according to treatises by Dr. E. Winkler, professor in Berlin, the following may be briefly mentioned:




Let $O$ be the origin of a system of co-ordinates $x$ and $y$ for points of the elastic line of a post $AB$, under the influence of a force $P$, which acts in a distance $f$ from the axis of the post at $A$. Let further $M$ be the moment of that force in reference to any cross section $C$, the co-ordinates of which are $x$ and $y$, then we have

(1.) $M = P(f + y_0 - y)$, where $y_0 = OA$

for the curve of deflection in the plane of $x$ and $y$, called the elastic line; we have then the differential equation:

(2.) $$\frac{d^2y}{dx^2} = \frac{P}{EW}(f + y_0 - y)$$

in which $E$ represents the modulus of elasticity and $W$ the moment of inertia of the section in reference to the neutral axis of the section vertical to plane $xy$. If $\frac{P}{EW}$ is replaced by $k^2$ (that is, $k^2 = \frac{P}{EW}$) then we get from equation (2) after double integration:

(3.) $y = f + y_0 + A \sin. kx + B. \cos. kx$

where $A$ and $B$ represent the two constants of integration, and $y_0$, $A$ and $B$ are to be defined. From the above figure, it may be seen that if $x = o$ then $y$ will equal $y_0$ and hence from equation (3).

(4.) $B = -f.$

Further, we see that if $x = l$ then $\frac{dy}{dx}$ will equal 0 (zero). Since $\frac{dy}{dx}$ represents the trigonometric tangent of the angle which a tangent at $B$ on the curve $ACB$ would form with $OB$, which is $= 0$, and for this reason we receive again from equation (3):

$$\frac{dy}{dx} = o + o + k A \cos. kx - k B \sin. kx, \text{ and}$$

for $x = l$ accordingly:

$$A \cos. kl = B \sin. kl,$$

wherefrom:

(5.) $A = B \tan. kl = -f \tan. kl.$

But since $x = l$ makes $y = o$ we receive again from equation (3):

$$y_0 = -f - A \sin. kl - B \cos. kl,$$

or

(6.) $$y_0 = f\frac{1 - \cos. kl}{\cos. kl}$$

and if now the values for $A$, $B$ and $y_0$, as obtained in equations (4) (5) and (6) are introduced in equation (3) we then receive:

(7.) $$y = f\frac{1 - \cos.(l - x)}{\cos. kl}$$

and this equation contains only known quantities, and represents the elastic line which could be constructed thereafter.

If we now substitute in the relation $k^2 = \frac{P}{EW}$ (as assumed above) for $k$ its value from equation (6), viz.: $k = \frac{1}{l} arcus. cos. \frac{f}{f + y_0}$, then we receive:

$$\frac{P}{EW} = \frac{1}{l^2} arcus. cos.^2 \frac{f}{f + y_0}$$

or

(8.) $$P = \frac{EW}{l^2} arcus. cos.^2 \frac{f}{f + y_0}$$

which represents the theoretic answer for the case assumed above. Starting from this relation between $P$ and the properties of the column and the material, we derive the above mentioned formula of the form:

$$s = \frac{s_1}{a\frac{l^2}{r^2} + 1}$$

as follows:

For very long posts the eccentricity $f$ compared with the deviation $y_0$ is only very small, and therefore in formula (8) $\frac{f}{f + y_0}$ small enough that we may neglect it, and we receive from equation (8) for a post which is free at *both* ends (put $l = 2\ l$):

(9.) $$P = \frac{4EW}{l^2} arcus. cos.^2 o = \frac{4EW}{l^2}\left(\frac{\pi}{2}\right)^2 = \frac{EW\pi^2}{l^2}$$

or generally with a factor of safety $= n$:

(10.) $$P = \frac{1}{n} A \frac{EW\pi^2}{l^2} = A s F \frac{EW\pi^2}{l^2 s_1 F}.$$

where $n = \frac{s_1}{s}$ and $s_1$, the crushing strength of the material per $\square''$, $s =$ the strain allowed per $\square'' = \frac{1}{n} s_1$; $F =$ section of the post in square inches, and $A$ represents a coefficient dependent upon the manner in which the ends of the columns are fixed (that is if both pin connected or if one pin and one square or if both square) and is to be investigated by experiments from formula (13 (below).

If we on the contrary assume very short columns, and if we suppose the strain on the surface of the

ends (either pin or square) being equally distributed we have simply:

$$(11.)\quad P = s\,F,$$

and if we combine the formulas (10) and (11) in the the expression:

$$(12.)\quad P = s\,F\,\frac{A\,E\,W\,\pi^2}{s_1\,F\,l^2 + A\,E\,W\,\pi^2}$$

we have a formula which shows that $P$ approaches the value $sF$ the more. the smaller $l$, that is the shorter the column will be and the value $\frac{A\,E\,W\,\pi^2}{l^2}$ the more the larger $l$, that is the longer the columns will be. According to this $P$ appears as a certain portion of $s\,F$ (the direct compression) which is the smaller the longer the column is compared with the dimensions of its section. By use of some transformation we derive from equation (12):

$$(13.)\quad \frac{P}{F} = s = \frac{1}{n}\,\frac{s_1}{\frac{s_1\,l^2}{A\,E\,\pi^2\,r^2} + 1}$$

where $r$ = the least radius of gyration, we recognize the above mentioned figure coefficient of $\frac{l^2}{r^2}$ being represented by $\frac{s_1}{A\,E\,\pi^2}$ and we see that in fact for each class of material of the same kind this factor will change and with it the formula (13) or $s$. This is the very reason why some results received from testing of columns calculated according to formulas as: $s = \frac{40{,}000}{\frac{l^2}{r^2}\,\frac{}{36{,}000} + 1}$ etc., will not agree with the results of the calculation or reversed, and therefore it is not the fault of the formulas being wrong, because these formulas suppose a certain modulus of elasticity and a certain $s_1$, which by no means are constant, but as we know, will vary with the variation or quality of our materials.

It becomes clear, therefore, that before calculating a section according to a formula of the above mentioned form $E$ and $s_1$, and $A$ (if the latter is not known before) ought to be ascertained by tests and the middle value of several such tests ought to be introduced for $E\,s_1$, and $A$. A such obtained formula used for calculation, and tests made with the column thereby received, if not reaching the crushing load of the material per □″ would prove that the material is not satisfactory, which could not otherwise be said. For this reason the great number of tests made in our time ought not to be made only to inquire how the test piece stands the test and how it changes its shape under the influence of increasing stress to which it is due, but from the ratios of the expansions to the forces applied that curve ought to be constructed the inclination of the tangent to the origin of which leads to the modulus of elasticity, that important factor, which, as in the above, so in a great many other technic mechanical disciplines forms the only condition under which theory and practice will meet.

Will you please find some space in your valuable paper for these few remarks on that subject and allow me to be, Yours respectfully,

Frederick Melber, C. E.,
Keystone Bridge Company, Pittsburgh.

## TO FIND THE TOTAL CURVATURE OF CURVES.

Halifax, N. S., Oct. 21, 1881.

Editor Engineering News:

On page 415 of your journal a correspondent gives a "table of multipliers for ascertaining the total curvature for any length or degree of curve," with a rule for its application. The following simple rule, deduced from the equation $n = \frac{\frac{1}{2}\,I}{D}$ in "Henck," is known to many engineers with whom I am acquainted.

$$L \times \frac{D}{100} = I.$$

$L$ = length of curve.
$D$ = deflection angle, or degree of curvature.
$I$ = angle of intersection, or total degree of curvature.

A table of multipliers seems unnecessary.

E. H. K.

## THE DAVIDSON STEAM PUMP.

It is claimed that the improvement in the M. T. Davidson steam pump is of great importance because it effects changes in such essential points as simplicity and efficiency. In that vital part of the pump—the steam end valve motion—a high degree of economy has been attained, and the working of the pump made absolutely noiseless.

The peculiarity of the steam end is that, unlike other direct-acting pumps, it has only one valve in the steam chest, which performs two duties, that of the ordinary slide valve and of the auxiliary valve combined. Its duty as a slide valve is to reciprocate across the steam ports to admit steam alternately to the two ends of the steam cylinder; and as an auxiliary valve it is oscillated so as to open and close the steam ports that lead to the ends of the steam chest.

The steam chest is cylindrical and bored out to make a face for the slide valve and to receive the pistons that assist in operating the valve. Sufficient space is allowed between the pistons, which are connected, for the valve and steam ports, and they are also connected to the slide valve, all working in the same plane and being of the same diameter, thus insuring evenness of wear and readiness of access for adjustment, repairs, etc. By this it is claimed that the getting out of order, becoming deranged or wearing out within the life of any other portion of the pump, is made an impossibility. The valve is oscillated by an oblique cam, connected with the valve by a steel pin passing through the valve into the exhaust port, in which the cam is placed. The latter is so constructed as to carry the valve mechanically and thus prevent the piston from striking the cylinder heads under any circumstances. This Mr. Davidson claims to be one of the most important features of his pump, the valve being as much under the control of the piston rod as the valve of the ordinary steam engine, worked by an eccentric instead of being independently worked by an auxiliary valve. The number of strokes per minute at which the pump can be run is greater than has been attained by any other direct-acting steam pump without danger, while an equal degree of superiority is achieved in the slow motion. The time required to overcome the inertia of the valve and plunger remains, while the distance moved by the pump piston varies with the velocity; it follows that the length of the stroke continues constant in the pump, a feature distinctly its own. The water end of the pump is a new design, being just patented, and is claimed by the inventor to be the only improvement made in this end of a steam pump for the last twenty years. It is simple, having only one inside joint to blow out, the improvement being the dispensing with inside or invisible joints.

There is no intermediate plate between suction and delivery chamber which is liable to spring, and if the inside joint does not blow out or become damaged, this springing of the plate allows the liquid to pass from one end of piston to the other, instead of being forced out of the discharge pipe. By the simple removal of one plate or bonnet these pumps can be examined, and they can be taken apart and put together again in two minutes, besides allowing the area of valves to be enlarged for any duty. Recently, one of the large Davidson compound pattern pumps was delivered to the Conglomerate Copper Mining Company, at Lake Superior. It has a capacity of 3,000,000 gallons in the twenty-four hours. with ninety feet piston speed. After a lengthy trial it was found to effect a saving in fuel by the greater quantity of water pumped, of forty per cent. over the steam pump that had been in use there.

The pumps being manufactured by the company specially for water-works purposes are guaranteed to perform the highest attainable duty for direct-acting steam pumps, and are claimed to be the only ones in which the valve is used mechanically.

In the improved Davidson pump the following important advantages are gained: A minimum af wear, economy, noiseless motion and high piston speed. It is also claimed that they can deliver a greater quantity of liquid per dollar, first cost, than any other pattern pump in the market. So confident are the company of the great efficiency of their pumps that they invite a public test, upon equal terms, with those of other manufacturers, before experts, and are certain the result would attest their superiority. We are indebted to Mr. M. T. Davidson for the information contained in this notice, and would refer those seeking further particulars of his invention to the works, 41 to 47 Keap street, Brooklyn.

## THE ADVANTAGES OF UNDERGROUND RAILROADS.

Before the Rapid Transit Commissioners for the city of Brooklyn, on the 13th inst., Mr. Samuel McElroy, the well-known civil engineer of that city, submitted the following statement:

In relation to the comparative advantages of the plans for rapid transit proposed for Brooklyn I am of the following opinion:

First.—It is the policy of the property owners to encourage and support all judicious plans for public improvements which tend to build up the city and the areas around it; to secure the emigrating surplus of New York City, and to increase the facilities for movement from the ferries and between various sections of the city. In a case where there is an annual exodus from New York of about one hundred thousand, Brooklyn, Kings County and Long Island can and should offer inducements superior to those of Westchester, New Jersey or Connecticut.

Second.—It is wise to locate the lines of transit so as to accommodate more directly the centers of business and population. Of these centers the City Hall is the most prominent, and from its lines radiating east, southeast and south are the most notable and direct outlets.

Third.—Proper judgment in construction dictates plans which will do the least damage to property, best accommodate the traveling public and be most easily and economically operated and maintained. Short as is the history of New York elevated roads, the question of this maintenance, physical and financial, is regarded with anxiety by the property owners they tend most directly to sustain.

In the light of theory and experience we may, on these points, examine the elevated plans.

### THE EFFECTS ON STREETS AND PROPERTY.

As to effects on streets and property, it is found that elevated railways, by their columns, interfere with the convenient use of carriage ways by a continued series of obstructions, dividing them into lanes; that columns and structures interfere with the engines and the erection and use of ladders in case of fire; obstruct light and air; discharge cinders, smoke and gas in windows; make injurious noises in residences, stores, hospitals and churches; injure sight, hearing, sleep and comfort, and reduce the taxable value largely.

As to property and persons, that structure and trains drop water, oil, spit, ashes, cinders, rust, tools, etc., on awnings, goods, horses, cars, carriages and pedestrians.

As to patrons, the stairways are narrow, steep and high; often overcrowded and exposed, with the platforms, to wind, dust and driving rain; platforms are narrow and crowded; the car entrances and exits are hurried and dangerous, and

on the trains many passengers suffer nausea from effects on sight and vibration.

As to structures and trains, there is constant exposure to the weather, steep grades on steep streets and abrupt curves, involving expensive and dangerous operation; risk of derailment at switches, and from collisions; and danger from hidden signals in snows and fogs; constant insecurity of operations on continuous bridges, built contrary to the best practice in construction; constant vibration, breaking rivets, weakening supports and foundations; excessive strains in stopping short at speed; amount and extra cost of repairs, painting and removals; exposure to special danger from high winds and frost; delays and injury from fires.

As to rapid transit, the speed is far below that of ordinary railways; with forty-six minutes running time to Harlem, eleven miles, the average rate is less than fifteen miles per hour.

As to cost of construction, the Manhattan elevated, including the Metropolitan, of 21.39 miles track, and the New York, of 18.28, represents:

| | |
|---|---|
| Bonds | $21,318,000 |
| Stock | 13,000,000 |
| Floating debt | 1,322,088 |
| Total | $35,600,088 |

or about $900,000 per mile.

As to cost in Brooklyn, the estimate of J. J. R. Croes, C. E., Sept. 6, 1880, was, for the cheapest structure, $293,680 per mile; the next, $327,360; the next, $337,920, and the fourth, $560,210, exclusive of stations, equipment and contingencies.

As to cost of operation, the Manhattan in 1880 spent for:

| | |
|---|---|
| Maintenance | $101,325 |
| Repairs to machinery | 306,199 |
| Operating about 57 3-10 per cent. of receipts | 2,236,801 |
| Total | $2,644,325 |
| Receipts | 4,612,975 |
| DEDUCTIONS: | |
| Interest | 1,133,958 |
| Rents | 20,000 |
| Taxes | |
| Damages | |
| Contracts | 1,300,000 |

Income therefore seriously deficient, on a transportation of 60,831,757 passengers, with 522 cars and 198 engines.

THE UNDERGROUND SYSTEM,

now in successful use in London and Glasgow, and in part in New York, Baltimore and elsewhere, on an extensive scale, obviates in a very important manner the injuries to property, persons, structures and equipment above enumerated, and presents much greater inducements to investment. It provides ample means of transit, reaches the main center of business, supplies the radial lines from the City Hall by much easier grades and direct lines, and can send its cars across the East River bridge, without subjecting property to damages for which there is no remedy, by structures, which cannot be considered permanent or safe.

The trains will travel noiselessly on their subterranean ways in roomy, well lighted, well ventilated passages of equable temperature at all seasons, and conveniently accessible by short stairways, free from storms, fogs, frosts, snows and vibrations on solid ground, where engines can be handled confidently, derailment is securely guarded and passengers can feel safe under a much greater rate of speed.

As to cost of construction, it is confidently believed that a full double-track tunnel 26 ft. wide by 16 ft. wide in the clear, with its incidental structures and work, can be built for about $400,000 a mile; that the cost of one and two-third miles to Atlantic avenue from the Fulton Ferry, as proposed, fully equipped and built, with stations, will not exceed $1,700,000, and of the entire work to Flatbush will not exceed $3,000,000, with a capacity of over 15,000,000 passengers annually.

As to income, the statistics are very decidedly in favor of the underground line. With 13.75 miles of line the London underground roads carried in 1880 about 63,000,000 passengers, with a receipt of about $2,400,000, the rates being 3.8 cents. As to operating expenses, the rate some time ago was 34 per cent. of the gross earnings.

As to the question of ventilation in connection with locomotion, I think recent improvements leave little room for doubt. Remarkable progress has been made in the use of gas from naphtha and superheated steam for engine combustion; the use of compressed air has been relieved from some of its chief hindrances, and I know from personal experiments that the mixture of compressed air and steam is easily made and an entire success in increased power with reduced expense. It is not necessary, therefore, to have a pound of coal in any underground lines, and its objectionable products of combustion may be kept out, while the steam exhaust is easily condensed in the engine.

Nor is there any embarrassment in disposing of sewers or sewerage with us, in any respect equal to the difficulties successfully met in the constructions in London, Glasgow or Baltimore, as to the maintenance of a comfortable and equable temperature in the tunnels, abundant means are at hand to regulate this, especially where compressed air becomes in part a motive power.

To these and like reasons, I have no hesitation in expressing a decided preference for a well-planned underground line, as compared with the present system of elevated construction.

Respectfully submitted,

SAMUEL MCELROY, Civil Engineer.

SOME QUESTIONS.

Counsellor Henry S. Bellows next put the following questions to Mr. McElroy:

Q. Are these elevated structures, as they are built, safe? A. Not permanently safe.

Q. Is it a matter of fact that iron bridges break down under the strain of wear, tear and travel? A. They do at times.

Q. Are these elevated railroads anything more than extended iron bridges? A. They are not.

Q. Is there not more danger really to be apprehended from the breaking down of an elevated rapid transit structure, on account of their curves, etc., than on a straight bridge? A. As a rule, yes. They endanger life and property.

Q. Is there not danger of the structures breaking on the curves? A. Yes.

Mr. McElroy stated that an underground railroad on Fulton street and Myrtle avenue is perfectly practicable, and that it possessed all the advantages of the elevated railroad system without its disadvantages. In some instances the elevated structure cost $900,000 per mile, while an underground road could be constructed for $400,000 per mile. The expense of constructing an underground road on Myrtle avenue would be less per mile than the damage to property.

## AN AMERICAN RAILROAD EXPERT IN ENGLAND.

The fact which first strikes an American who is specially interested in railroads, on visiting England, is the enormous traffic of the English lines. Most of the terminal, and some of the other stations, are very large, and are nearly always thronged with people and, apparently, there is a constant succession of trains coming and going without cessation. The yards at junctions and approaches to stations look like an inextricable network of tracks, and the signals, on a forest of posts, seem to be waving their arms by daylight and staring with red eyes at night in hopeless dispair over the task of controlling the movement of trains which seems almost uncontrollable.

That the traffic on English lines, for a given length of road, must be very much greater than in the United States, becomes statistically apparent if a comparison is made of the number of locomotives, in proportion to the miles of track worked, of some of the principal companies in the two countries. The following table gives the number of miles of road worked and locomotives owned, and the miles of road per locomotive, for a number of the prominent lines in England and the United States:

| Name of road. | Miles of road open. | No. of locomotives. | No. of miles of road per locomotive. |
|---|---|---|---|
| ENGLISH LINES. | | | |
| Great Western | 1,550 | 2,147 | 0.72 |
| London & Northwestern | 1,716 | 2,182 | 0.78 |
| Midland | 1,518 | 1,716 | 0.88 |
| Northeastern | 1,364 | 1,490 | 0.91 |
| Great Northern | 659 | 601 | 1.09 |
| AMERICAN LINES. | | | |
| Pennsylvania | 1,120 | 627 | 1.79 |
| New York Central | 1,018 | 639 | 1.59 |
| New York & New Haven | 202½ | 97 | 2.09 |
| Chicago, Burlington & Quincy | 2,772 | 441 | 6.28 |
| Lake Shore | 1,178 | 494 | 2.38 |

From these figures it will be seen that one of the above English lines has a locomotive for less than three-quarters of a mile of road, two others for less than seven-eighths of a mile, and one for less than a mile. It is not certain either that these have the largest relative equipment in the country, but the data concerning them are the only ones accessible as this letter is written.

From the hotel where Americans most do congregate in Liverpool, it is but a few minutes walk to either the Northwestern or the Midland Railway stations. Accidentally the former was visited first, and, contrary to expectation, it was found that the whole of it was open to the public, to go wheresoever it pleased. The first impression produced by the sight of an English train was its extremely diminutive size. This was true of both the passenger cars, or "carriages," as they are called here, and the engines, although of the latter it is more apparent than real, owing to the absence of the large cabs and cow-catchers universal in the United States. Another noticeable feature was the comparative silence with which trains entered and left the station. There was little or none of the clang of an American train, but the English vehicles seemed almost shod with India-rubber, so noiseless were their movements. This observation has since been confirmed at other stations and on other lines, but at present the reason for it is not clearly apparent.

The panels in the upper portions above the window sills, of the Northwestern "carriages," are painted white, and below the windows a dark brown, the effect of which is somewhat like that produced by the spotted and striped circus horses which most of us admired so much in youthful days. The little four-wheeled cars, without end platforms or clear-stories on top, and the engines with only a semblance of cabs, looked almost like playing at railroading. Of course, this is not the expression of any opinion, other than that produced upon an American by first sight and a few minutes observation in a great English station.

When, however, attention was directed to the track, and not to the rolling stock, the impression was the reverse of the first one. As most of the readers of the *Railroad Gazette* probably know, very few flat-bottomed, or what are called Vignoles, rails are used in Great Britain. Almost universally the form of the sections with which the lines are laid is either double-headed, or what is called bull-headed pattern. These are laid or held in cast-iron chairs bolted to the sleepers. The former have two lugs, or projections, between which the rails are fastened by a wooden wedge. Consequently they stand about two to three inches above the sleepers, and as their weight is about 84 lbs. per yard, the track has the appearance of great massiveness, if compared with that in common use on American lines.

The journey from Liverpool to London afforded the first opportunity of riding in an English "railway carriage." To get the most favorable impression the first-class was selected. As the question of the relative comfort of the British carriages and American cars is so often discussed, a few observations about the construction of the former, so far as it relates to the comfort of passengers, may be interesting to many readers. The dimensions of the seats on the Midland Railway, the line on which the journey was made from Liverpool to London, were not taken, but on another road, the Great Northern, on which the carriages are arranged substantially as on the Midland, the seats were measured. The body was 7 ft. 3 in. wide inside, and the compartment 7 ft. long. The seats are arranged tranversely, the passengers sitting to face each other, the space being divided into three seats in front and three back. The width of the seats measured crosswise of a person sitting in them was 29 in., measured from center to center of the arm-rests, 19 in. in the clear between the latter. The arm-rests were, therefore, 10 in. wide, giving room enough for the arms of two passengers. The former at the sides of the carriage were only half this width, and intended for one passenger only. The depth of the seats was 30 in., measuring from the partitions which formed the compartment to their outer edge. The upholstery was 9 in. thick in the back just above the seat, so that the depth of the latter, in the clear, was 21 in. The upholstery was carried up high enough to support a passenger's head, and side rests were also provided for its support. The seats were also inclined backward.

There were two points of marked superiority in their comfort over any seats the writer has ever seen in American cars. First, there was more room, and, second, the upholstery of the back was so arranged as to be much more comfortable than that used in either the drawing-room or ordinary cars in the United States. The superiority of the English upholstery seems to be that they aim to give support to the lower part of the spinal column, which has fewer muscles and bones to sustain it than the upper part has. To do this the back, just above the seat, is made to project about 6 or 7 in. further out than it does higher up. The projection is formed of light springs and hair, so as to make a soft cushion, which adjusts itself to the form of the body, and at the same time supports it where it needs support. In the upper part of the back softness is not so much aimed at. The result is a seat which is much more comfortable than any which American car upholsterers or car-builders have thus far given their countrymen.

The Midland Company, on its principal day

trains, runs Pullman drawing-room cars. Now it would be quite unjust not to give Mr. Pullman and his company credit for the many improvements they have made in car construction. They changed the sleeping cars of America from dens of nastiness to clean and decent habitations for weary travelers, in which the latter may rest without either entomological or pestilential fears. The odor, if not of sanctity, at least of cleanliness, which is next to it, goes with his cars the world over, and many a tired wayfarer has lain down in blessing the man who invented both sleep and sleeping cars. But the art of making comfortable seats is one which the Pullman Company has not excelled in, as any one may know on the Midland road who will try the drawing-room cars and a first-class English carriage as the writer did. Their relative comfort is that of a new and old shoe.

Of the compartment system it may be said that there is not the slightest probability of its ever coming into use in America. The difficulty of providing communication between the compartments and the other portions of the cars is fatal to it for long journeys. The danger, too, of personal violence to passengers if shut up with strangers, of which all travelers in Great Britain stand in more or less fear, would probably be no less in the United States, especialiy on the borders of civilization, than it is on British soil.

Means of communicating with the guard and engine "driver," as he is called here, has been a subject on which English ingenuity has long been exercised. The following notice, copied from one in a new Midland carriage, will indicate the progress which has been made in this direction:

"Directions for using the means of communicating between the passengers and the servants of the company.

"To call the attention of the guard and driver, passengers must pull down the cord which will be found outside the carriage close to the cornice over the window of the carriage door. There are cords on both sides of the train, but that on the *right hand side* in the direction in which the train is running is the only one *by which alone the communication can be made.*

"Passengers are earnestly requested themselves to protect the communication from improper and mischievous use, as it is very important that it should not be used without real and urgent necessity. Under the provisions of the Regulations of Railway Acts, cap. 119, any passenger who makes use of the communication without reasonable and sufficient cause will be liable for each offense to a penalty not exceeding five pounds."

This notice was printed in a circular form about 4½ to 5 in. in diameter. Some of the lines of the print were straight, others semi-circular, so that it was puite difficult to read even when near to it, and quite impossible when some distance off, without standing up. It seems as though it would be very improbable that this notice would be understood or that passengers would be able to follow its directions in case of a sudden accident, and railroad accidents are nearly always sudden.

It would be very unwise, though, to pronounce decidedly against the English system of "carriages" on the limited knowledge that could be gained by a few journeys on their lines. The social relations, the physical conditions, the habits of the people, all have their influence in determining their methods of travel. The lower classes of the people in Great Britain are poorer, as a rule, less cleanly in their dress, and in almost every way lower down than in America. The line of separation between them and the middle and upper classes is more distinctly defined, and in traveling, as well as in other relations, it is recognized and demanded. It may be said, to the credit of all classes of English travelers, though, that they do not expectorate, in the carriages or out of them, so that abomination, from which decent people in the United States suffer so much, is not often encountered here.

A great deal may be said both for and against the division of travelers into three classes. Practically, on many of our own lines they are divided into two classes by the use of drawing-room and sleeping cars. In England, if a poor person wants to travel at a low rate of fare, and does not care much what kind of fellow-passengers he travels with, he buys a third-class ticket. If he values cleanliness, but does not want to incur the expense of the first-class, he goes second, at a moderate rate, and, if inclined to be exclusive, pays a high rate for a seat in a first-class compartment. The result is that all parties are better accommodated than they would be with one class only, even if supplemented with our expensive sleeping and drawing-room cars. It is a question which might be well worth the consideration of some of the managers of the lines in the more populous sections of the United States, whether it would not pay to run cheap cars on all, or nearly all, passenger trains to correspond with the third-class English carriages, the rates of fare to be reduced sufficiently to lead the poorer class of people to travel. The extent to which this kind of travel may be stimulated by low rates has been shown by the Sound boats from New York.

Of the general construction of the carriages only a brief notice will be given, more detailed accounts being left for future comments and observations in the shops and works of different lines. The carriages, generally, have either four or six wheels, 42 in. in diameter. The Midland and the Manchester, Sheffield & Lincolnshire lines are, however, using a considerable number of double truck or "bogie" carriages, similar to those in use in America. Possibly other lines may be using them which have not yet been visited. The general opinion of the managers who are using "bogie" carriages, as to their relative merits, if compared with those ordinarily employed, seems to be rather undecided, or, at least, is very cautiously expressed. The following statement of the weights of a four-wheeled carriage and one with six-wheeled bogies will show their relative weights. The former is 30 ft. long over the body and has two first-class and two second-class compartments and one for luggage; it will seat 12 first-class and 20 second-class passengers, or 32 in all, and weighs 11 tons 10 cwt., or 805 lbs. per passenger. The bogie carriage is 54 ft. long over body with six-wheeled trucks, has three first and four third-class compartments and one for luggage, and seats 18 first and 40 third-class passengers, or 58 in all, and weighs 23 tons, or 888 lbs. per passenger, or 83 more than the other. Some English managers, like some of their brethren in America, are inclined to assign more importance to a comparatively small excess of dead weight than is properly due to it. There has been a great deal of fallacious reasoning about it on both sides of the Atlantic.

Any one who will travel in the two kinds of carriages must find that the motion of the bogie cars, whatever the merits of that system may be, certainly is much easier and pleasanter than that of the four and six-wheeled carriages, notwithstanding the fact that the English roads are ordinarily kept in such excellent condition.

The fact that a bogie carriage rides much easier than one of the European type, with four or six wheels, is indicated also by the care with which the latter is supported on its springs. These springs are of what seems to an American inordinate length, but doubtless we might imitate English practice in this respect to advantage and to the comfort of travelers. Some of the springs on the Midland road are 7 ft. long and consist of seven plates ½ in. thick and 4 or 4½ in. wide. It is said on this and other roads that they rarely break, although on some of the lines the inspection of them is much more rigid than it is on many lines in America.

Double buffers, near the outside of the carriages and wagons, are universally used, and so are hooks for coupling, instead of draw-heads. A kind of double turn-buckle arrangement, with a screw between its two parts, is used for connecting the hooks together. When the former is attached to the hooks, the screw is turned by a weighted lever attached to it, and the buffers of the two carriages are thus drawn together and more or less compressed. On "goods wagons" a chain of three or four links, similar to those on some of the four-wheeled cars of the Pennsylvania coal roads, is used for coupling.

The arrangement of lamps on the carriages is novel, and a little amusing at first to an American. The carriages are seldom built with what in America is now called a clear-story in the roof. To provide for the lamps a round hole about 12 in. in diameter is cut in the roof of each compartment, and the lamp is inserted into this opening by a man on top of the roof. The lamps are all made duplicates of each other, and the burner is inclosed in a glass guard or globe about the size and shape of half of a good-sized watermelon, cut in two transversely, the hemispherical part being below the burner and the flat part or place corresponding to that which would be cut in the melon being open and above. These glasses are not unlike those used on some street lamps, of recent date, to be found in most of our cities, and being below the burner they cast no shadow. In nearly all of the principal stations there are lamp-rooms in which a supply of carriage lamps is kept and trimmed and lighted for trains as they may require them. A sufficient number for a train is put on a truck and wheeled alongside the former, and the lamps are then handed up to a man on top of the cars by another on the platform by a long stick with a hook on its end, to which the lamp is attached. The man on top opens a cover on a cylindrical receptacle over the hole in the roof, into which the lamp is inserted. In removing the lamps the man on top takes them out of their receptacle and throws them down to the attendant below, who "catches them on the fly," and keeps the looker-on at first in a lively anticipation of the delight of seeing some of them smashed, but, owing to the skill of the men, they never seem to confer this pleasure. When the lights are to be put out, but the lamps not removed, a man goes over the tops of the carriages, opens the covers of the lamp receptacles, and inserts a tin tube to the lamp flame, and a puff of air from his mouth through the tube does the work without the necessity of lifting out the lamps.

This letter might be almost indefinitely extended, by relating the novelties and oddities, or what seem such, that an American sees on first traveling over English roads. Further accounts of these will be reserved, though, until more specific descriptions of shops and other places of interest which have been and will be visited are given.—*M. N. Forney, in Railroad Gazette.*

## WATER IN PARIS.

Like New York and all other towns in which there is a continual increase of population, Paris has to confront the question of how to keep up the water supply. A great many things are admirably done in France, but they do not manage this important business of furnishing the first necessary of life in a very successful manner there. Last July the Prefect of the Seine gave notice that the supply of water in the reservoirs of the city was diminishing at an alarming rate, and that unless the consumption was limited to what was strictly indispensable the Government would have to establish a system of water rations. In fact, the Prefect spoke to the Parisians much as he might have done had they been in a state of blockade or siege. The present means of supplying water to Paris are based upon the plans of M. Belgrand, who in 1854 was directed to examine all the sources from which water could conveniently be drawn to supply the city. It was stipulated, to begin with, that these sources must be at such an altitude that the water would rise as high as Belleville. M. Belgrand, who was chief of the hydraulic engineers of the Seine, performed his task in a thorough manner. He analyzed the contents of 229 springs and other water sources, made daily observations of their temperature in summer and in winter, and calculated the amount of water they could furnish. In accordance with his recommendations the city purchased the head waters of the Dhuys, near Chateau Thieny, which gives 1,412,000 cubic feet of water a day, and the sources of the Vanne, a little stream between Troyes and Sens, which furnishes daily some 2,366,000 cubic feet of water. Two aqueducts were designed to convey these waters to the metropolis. As the water of the Dhuys was charged to excess with carbonate of lime, it was turned into a miniature cataract, falling in spray before entering the aqueduct. The object of this was to get rid of the excess of lime. Then a double aqueduct, about 3,280 feet in length, was built, in order that there might be no interruption of the supply to the city in case the water made deposits or incrustations in the aqueduct that must be removed. The aqueduct runs along the hills which border the left bank of the Marne, as far as Chalifert. It crosses the river there, and then runs along the right bank to Belleville. The total length is about eighty-seven miles. The aqueduct throughout most of its course consists of tunnels of masonry. These tunnels are joined together in places where valleys have to be crossed by pipes buried about 3¼ feet below the surface. The water is discharged into cisterns which are capable of holding about 26,380,000 gallons of water. They are covered over with earth and sods, and thus keep the temperature of the water very nearly as low as it is at the source. It is claimed that such reservoirs render impossible the development of living organisms in the water.

The waters of the Vanne are conducted by an immense canal to the reservoirs of Montsouris. This canal or aqueduct is carried on a magnificent series of arches, which seem endless as they span the fields and rivers. Taking account of all sources of supply, it is estimated that Paris furnishes only a little more than one-third of the supply to each inhabitant that New York gives, and not one-fourth of that furnished to each inhabitant of Rome.

Before the works mentioned were begun, Paris received its water from various sources. The Romans, of course, built aqueducts when they were lords of Lutelia Parisiorum, and remains of their

constructions are visible at the Thermes at the Hotel Cluny. In the middle ages water was occasionally so scarce that the inhabitants were almost driven out of some quarters of the city. Even after the aqueduct of Belleville was constructed, in 1457, Paris received only about 10,600 cubic feet of water a day, that is, a little more than two pints a head. This supply, moreover, was very unjustly distributed, the bulk of it going to the rich abbeys of the clergy or the palaces of the nobles. Henry IV., who wished that every Frenchman should have a chicken in his pot, determined that the poor man should have water to boil his chicken in. He therefore cut off all the special pipes and conduits that supplied the clergymen and noblemen, and made everybody who wanted a private supply of water pay heavily for it. He erected the fountain of the Samaritaine on the Pont Neuf, and ordered the reconstruction of the old Roman aqueduct at Aveneil. Pumps were also placed in the river at various points. Louis XIV. allowed all kinds of abuses to creep in. He spent millions upon his fountains at Versailles, but did nothing for Paris beyond the erection of the pump at Notre Dame. Paris in 1671 received about 6½ pints of water a day for each inhabitant.

The beginning of the eighteenth century was occupied by discussions upon the question whether it was better to bring water from a distance or to pump it up from the Seine. Finally the brothers Perier proposed to erect steam pumps, and they obtained letters patent from Parliament. The first pump was built at Chaillot, close to the mouth of the great sewer. With such a commencement the company was not likely to succeed. All its promises were broken, and the Government was compelled to interfere. The defender of the company was the celebrated Beaumarchais; its leading assailant was Mirabeau. Nimble Figaro was no match for the Orator of the Revolution. At this time Paris had half a million inhabitants, and each was supplied with nearly fifteen quarts of water a day. In 1797 the great canal of the Ourcq was projected. The work was begun in 1801, continued till 1812, then suspended, and finally completed in 1837. With this canal, eighteen steam pumps in the Seine, and the artesian wells of Passy and Grenelle, Paris received in 1864 only a little over 7,000,000 cubic feet of water a day, or about thirty gallons a head. Under these circumstances it is not surprising that a Parisian washstand was supplied with vessels no larger than a soup plate and a cream jug, and that baths in houses were almost unknown.

## THE RAILROADS AND THE FARMERS.

Colonel W. F. Vilas, the famous Wisconsin orator, delivered the annual address before the Minnesota State Fair, and chose for his theme the "Railroads and the Farmers," and tried to point out their reciprocity of interest. A few extracts from his admirable speech will convince the reader of its superior excellence and soundness:

Demagogues love to thrum our eardrums with their clamor of the wrongs the agriculturist suffers, and stir a spirit of unrest. Their regular outcries are doubtless proof of the healthy condition of our free political atmosphere; but sometimes this mark of salubrity seems a trifle too abundant. Calm wisdom, with a broader view, superior to the irritations of the passing moment, perceives the solid foundations for satisfaction in our present state, and sure hopes for a steady progress with advancing years.

Before railroads were devised there was no extensive freight communication but by water. And that was valueless unless conveniently accessible. From this the agriculture of past ages gathered around the seas and lakes, or lined the river's margin. It girt the Mediterranean and made famous the valley of the Nile. The unwatered world of the interior was left to the wandering nomad or the forest barbarian. It was the unknown region full of mysterious terrors. The great Hercynian wood was the home of beasts, brute and human, the latter ever the impending peril, and finally the destroyer of the civilization of the world. The reserve corps of barbarism lay back on the plains of Russia and Tartary, which nourished the fierce savages who could live on equine flesh and carouse on the milk of mares. So, too, water communication was slow and tedious, even when accessible. That is true, especially of inland navigation. It is weeks by water from St. Paul to New York, though the aid of water be invoked; and in northern climes navigation is available for but half the year. Your magnificent wheat fields would mostly be unbroken, farmers of Minnesota, had not the invention and enterprise of other men, stimulated by your demands, laid the double-lined highway by which the freight-car bears your precious berry to the sea, and the Indian would still be master of the Territories of the West.

Your lands derive their value, your industry its reward, your homes the luxuries and many of the comforts they exhibit, from the well-abused railroads of the continent. In the beautiful language of that noble lover of human liberty, once the pride and ornament of Wisconsin's Supreme bench, the lamented Byron Paine: "Railroads are the great public highways of the world, along which the gigantic currents of trade and travel continuously pour—highways compared with which the most magnificent highways of antiquity dwindle into insignificance. They are the most marvelous inventions of modern times. They have done more to develop the wealth and resources, to stimulate the industry, reward the labor and promote the general comfort and prosperity of the country than any other, and perhaps than all other mere physical causes combined. There is probably not a man, woman or child whose interest or comfort has not been in some degree subserved by them. They bring to our doors the productions of the earth. They enable us to anticipate and protract the seasons. They enable the inhabitants of each clime to enjoy the pleasure and luxuries of all. They scatter the productions of the press and literature broadcast through the country, with amazing rapidity. There is scarcely a want, wish, or aspiration of the human heart which they do not in some measure tend to gratify. They promote the pleasures of social life and of friendship, they bring the skilled physician swiftly from a distance to attend the sick and the wounded, and enable the absent friend to be present at the bedside of the dying. They have more than realized the fabulous conception of the Eastern imagination, which pictured the genii as transporting inhabited palaces through the air. They take a train of inhabited palaces from the Atlantic coast, and with a marvelous swiftness, deposit it on the shores that are washed by the Pacific seas. In war they transport the armies and supplies of the government with the greatest celerity, and carry forward, as it were, on the wings of the wind, relief and comfort to those who are stretched bleeding and wounded on the field of battle."

But while we do them justice, let us not forget there are doubtless many faults to be corrected and abuses to be reformed in the administration of these highways. Corporate powers and corporate values have advanced with a more rapid step than the invention of our statesmen and law-makers. The agency of the corporation is comparatively modern, and, like the agency of steam, is a mighty power. Unless subdued by proper appliances of law sufficient to control it, we are liable to disasters ruinous to our welfare, as the accidents which sometimes befall the train are destructive of life.

But I must not protract this weary hour to discuss this problem foreign to my subject. Important as it is, we need not fear it. The railroad, rightly used, is the friend of the farmer and the whole people, It is the paramount interest of its owners that it should so remain. They dare not make it an enemy, and when we reflect that a single invention—the steel rail—has reduced the freight tariff 40 per centum, we may trust somewhat to time and genius to relieve the inconveniences, and continue to enjoy its blessings with composure.

## LIVERPOOL ENGINEERING SOCIETY.

The usual meeting of this society was held at the Royal Institution, Colquitt Street, on Wednesday evening, the 12th inst., at 8 o'clock, the Vice-President in the chair, when a paper on "Slate Quarrying" was read by Mr. C. H. Darbishire, Assoc. M. Inst. C. E. The paper dealt chiefly with slate quarrying as carried on in the Nantle Valley, and the several beds or veins of slate that are worked therein. The author commenced by alluding to the rock as having been formed of great deposits of mud in water, composed chiefly of silica and alumina which have been subjected to immense pressure and volcanic convulsion. The split of the slate is attributed in a great measure to the effects of the great pressure. The paper further described the several means of opening quarries, whether on the hill-sides or on the flat, and alluded to the different apparatuses in common use, advocating inclines instead of the old-fashioned guide-ropes and hauling-chain. Attention was called to the system of bargains under which, practically, all roofing slates are made, as well as the duties undertaken by the rock men and quarrymen respectively and their tools. The ordinary sawing machinery was described as well as the dressing machines in vogue, preference being given to the one invented by the late Mr. Greaves. The explosives mentioned were powder, nitro-glycerine, dynamite and gun-cotton, all being more or less employed, with the exception of nitro-glycerine, the use of which has now been almost abandoned. In pure slate the common black powder only is burnt. The author concluded by pointing out that a quarry venture is not necessarily a success, because there happens to be some good splitting slate found therein, but thought that if sufficient good rock is found few ventures are so safe or so lasting. A vote of thanks to the author for his interesting paper concluded the meeting.

## SOIL AND ITS RELATIONS TO HEALTH.

The fifty-fourth assembly of German Naturalists and Physicians at Salzburg opened on Sept. 16 with an address by Professor Pettenkofer on the "Soil and its Relations to Health." The Professor, who is perhaps the greatest living authority on what might be called meteorological hygiene, prefaced his remarks by saying that the first consideration of air, water and soil in their sanitary relations dates as far back as Hippocrates—two thousand years ago; but hitherto hygienic practices have been guided almost entirely by instinct and what is called common sense, and it is only recently that a scientific basis has been secured for them, chiefly through the germ theory of diseases. It has heretofore been assumed that the hygienic condition of the air deserved the first consideration, then that of the water, and finally that of the soil; but it now seems as if this order would have to be reversed. It has been found that there are some cities which enjoy a complete, or almost complete, immunity from certain epidemic diseases, such as cholera. Salzburg is one of these cities and Lyons another. Whenever the cholera makes its appearance in Paris or Marseilles the rich inhabitants go to Lyons, which, although it is situated just between these two centers of infection, remains intact. And it has been proved that this is not due to superior cleanliness, better water, or more favorable atmospheric conditions, as it is only some twenty years since the city was first supplied with filtered Rhone water, while the plateau of Languedoc is not protected, even by the frequent storms that visit it, from the disease. The average rate at which air moves is about three meters a second, and if this air contains in one locality noxious germs which it does not contain in another, they can only be derived from the soil. As the air moves along they disappear through diffusion or dilution just as, in the Seine, which is polluted by the sewage of Paris, no impurities whatever are found at Meulan, a few miles below Paris. As for the water, many cases of infection are known where its agency was strictly excluded, so that, although it would not do to pronounce dogmatically against the water theory, it must be said that as yet it lacks cogent evidence.

The influence of the soil in predisposing to disease is also strikingly shown on shipboard, where only those persons who come from certain localities are attacked; so that it is regarded as the best measure for the ship to cut off all communication with the shore at once by going to sea, where the disease as a rule soon disappears, because the ship in itself must be classed among those localities which do not spontaneously breed the disease. Experience has shown that alluvial soil is the favorite resort of certain infectious diseases. This is due to the fact that such soil is very porous, and therefore contains a large amount of air, water and organic material, which conduce to the rapid growth and multiplication of the microscopic bacteria whose introduction in the human system gives rise to disease. The fact that large, heavy buildings are often erected on soil a third of whose volume consists of air, shows that the porosity of the soil is greater than is usually imagined. It shows also the importance of protecting houses from the poisonous germs which are bred in these pores of the soil. In winter, and on many summer nights, when the air in our houses is warmer than the ground, the houses act like flues in sucking up the gases contained in it. Pettenkofer regards the system of canalization now adopted in most cities as an important safeguard against danger. The opponents of this system urge that the network of canals can never be made complete and absolutely free from leaks, so that the soil will always be polluted to some extent after all; but the answer to this objection is that so small an amount of pollution is neutralized by the activity of certain kinds of bacteria which act as a sort of scavenger in destroying the noxious bacteria. "These lowest representatives of organic life can therefore be made useful to us, too, and we must not be surprised if in fu-

ture times the useful bacteria will be actually cultivated and only those that are noxious thwarted in their struggle for existence." This last sentence is the most striking one in the lecture, and one cannot help associating it with the prophecy uttered by Pasteur at the late Medical Congress at London, that the recent discovery that vaccination is useful in several infectious diseases besides small-pox points perhaps to a general law, by which the influence of one kind of microbe may be counteracted by that of another kind.—*The Nation.*

## WATER SUPPLY AND WASTE.

The engineers of the Water Department report that no rain of any account has yet fallen in the water-shed of the Croton River, and that the scarcity of water in storage has not yet been relieved. The possibility that the drought may be continued to the extent of cutting off the city's supply is, however, so remote as not yet to excite much alarm, although the necessity of husbanding present resources still continues. The department is doing everything in its powers to enforce economy in the use of water. About 5,000 water meters are now in use. All railways, hotels and breweries have them. Meters have not been put in all factories, but it is the policy of the department to put them in as fast as possible. The charge for water is one cent per 100 gallons, and the effect of this tax is to reduce the use of water to actual requirements. Since the meters have been put in, the hotels have generally resorted to wells for half their supply. Steam engines consume 7½ gallons per horse-power per hour, and the total consumption of this kind is necessarily large; but it is the opinion of the department that there is no waste of water here. Engineer Birdsall said recently that the amount of water used for steam power, except by the railway companies, would not amount to a million gallons a day. The railways—elevated roads and all—use about one and a third millions of gallons daily, the hotels about one and a fourth millions. The different charitable institutions are prodigal users of water. "The new hospital on Fifteenth street," said Engineer Birdsall, "averages about 200 gallons a day for each of its inmates."

The waste of water is said to occur chiefly in private residences. To get at this waste the department on July 14 began a work never before undertaken. Inspectors were stationed in the sewers between midnight and 6 o'clock in the morning to note the escape of water from house connections. The results of their examinations have been compiled up to Oct. 1, and show that from 811 houses whose waste was large enough to report, the flow was less than a gallon a minute; from 102 houses there was a flow of from one to five gallons per minute, and from 13 houses there was a flow of over five gallons a minute. In a few cases the waste was over six gallons a minute. The department has no power to impose any penalties for such waste, and all that can be done is to call the attention of householders to the matter, and threaten to shut off their supply if the abuse is continued. It was found that some families thought it a healthful precaution to let the water run all night. As a matter of fact, the practice amounts to a disuse of the plumbing arrangements made to prevent the entrance of sewer gas into houses. Eight men are still engaged in this work of inspection, and good results have followed. The department, however, thinks it would be an economy to have a water meter in every house. When a meter is introduced, its cost is generally saved in the first three months, and after that the householder economizes in the use of water.

## EADS' SHIP RAILWAY.

The suggestion of a ship railroad dates back from the adventurous epoch and from the busy brain of Cortez. The "wild surmise" which held Balboa "silent upon a peak in Darien" very soon gave way to a depressing conviction that there was an obstacle in the way of Columbus' idea of reaching the East by way of the West, and Cortez was not content with merely conquering Mexico as long as anything remained beyond. He made a personal exploration of the Coatzacoalcos, the river of the isthmus, with a view of establishing a portage across the short path to the South Sea, for the rich commerce of Zipangu and far Cathay. Spain thought well of the project, and, after three hundred years of thinking, issued a decree in 1814 authorizing the attempt. But the revolution had already started, and prevented all further proceedings until 1842, when the republic granted a concession to Don José de Garay to build a railroad there. The Garay concession lapsed, although the government of the United States was prepared to pay fifteen millions of dollars for a right of way across the isthmus, and authorized the commissioners of the boundary treaty to offer that sum to Mexico. This, too, fell through; but after the gold discoveries of California our government kept its eye on the isthmus, and has since made two surveys for the purpose of determining the practicability of a canal. These surveys were made by General Barnard in 1851, and by Commodore Shufeldt in 1870; but it looks as if the isthmus was waiting for the ship railroad, for in the interval three successive concessions were made to Mexicans, and one to an American company; yet the Panama Canal, twelve hundred miles farther away from us, was begun before the Mexican government turned a willing ear to the idea of Eads.

The idea of Eads is that wherever a canal can be dug to float a ship, a railroad can be built to carry a ship; and, strange and novel as the idea sounds upon its first mention, the most sober-minded and competent engineers of this country and of England declare that it is scientifically sound and quite practicable.—*Harper's Magazine for November.*

## EADS' JETTIES.

The St. Louis Exchange, after hearing the report of a committee appointed to investigate the subject of the South Pass Jetties, adopted the following resolutions as an expression of their body:—

*Resolved*, That the statements published by the *Cincinnati Commercial* and the Memphis *Avalanche*, to the effect that the channel through the jetties at the mouth of the Mississippi River is and has been deficient, and that the work is a failure, are wholly unfounded in fact; that a careful investigation of the facts has shown the minimum channel of 200 feet in width and 26 feet in depth, required by law, to be and have been fully maintained; that said channel is a permanent one, and is broad and deep enough to accommodate the largest class of merchant vessels.

*Resolved*, That we emphatically condemn the publication of the articles referred to, and do pronounce them injurious to the interests of the commerce of the Mississippi Valley.

## THE APPRENTICES' LIBRARY.

This valuable public institution, which is maintained at No. 18 East Sixteenth Street by the General Society of Mechanics and Tradesmen, has just entered upon its sixty-first season. There are now 60,000 volumes on its shelves, including all the different branches of science, art and literature. During the past year, in a circulation of 160,000 volumes among 8,247 readers, the library lost only 39 books. The reading-room contains all of the current periodical literature and a large reference library. Thirty thousand persons patronized this institution during the past year. No admission fee is required either to the library or reading-room, and they are open from 8 o'clock a. m. to 9 p. m.

# GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

## GAS AND WATER.

The engine-house and smoke-stack of the Lagonda, O., water-works are nearing completion.

The water commissioners of Northampton, Mass., will lay in all some 6,000 feet of pipe in various pa of the town this year, mostly of the 4-inch size.

A meeting has been held at Barrie, Ont., to discuss the subject of water supply. A local firm offers to provide a system of water-works which will cost $40,000 for a subsidy of $2,500 per annum.

The proposed water-works scheme at Kent, O., is meeting with a good deal of opposition, and indications are that the vote will not be carried. Tuesday, Nov. 1, is the day set for a special election to decide the question.

The engineer employed by the Hamilton, O., Council to make a plat of that city, with a view to the erection of water-works, has submitted his report to the Committee on Water-works, and which will be presented to Council at its meeting on Tuesday night next.

An error occurred in our notice last week of the extension of the water-works of Indianapolis. The filter gallery will be 5,000 ft. long at first, instead of "500 to 900 ft." as printed. Its length is based on an assumed yield of 600 gallons per day for each linear foot.

A special meeting was held (Oct. 22) of the committee of City Council with regard to the water supply of Belleville, Ont. Messrs. Gamble & Co., of New York, who propose to construct works, were invited to send an engineer.

The Otis Tube Works Company, of Cleveland, O., has been incorporated by W. L. Otis, Edward Lewis, B. F. Rouse, M. M. Murphy and L. L. Otis for the purpose of manufacturing wrought-iron pipe and tubing of all sizes, boiler flues, steam-fitters, tools and supplies. Capital stock, $100,000. The company's works will be located on Hamilton street, at the Cleveland & Pittsburgh Railway crossing.

Commissioner John French, of the Brooklyn Department of City Works, has issued an appeal to the citizens urging the necessity for great care to prevent the wasting of water, and stating that the use of water for street sprinkling, for fountains and garden purposes and for washing sidewalks and the fronts of houses, must be discontinued. The rainfall for July, August, September and October of this year has been but 5 39-100 inches, as against 17 89-100 during the corresponding period of 1880, while the average daily consumption has been between 4,000,000 and 5,000,000 gallons greater.

## ELECTRICITY.

The American Electric Railway and Power Company filed articles of association on the 24th: capital, $10,000,000. The principal office will be in New York.

John Stambaugh, H. O. Bonnell, Robert McCurdy, J. H. McEwen and W. A. Baldwin are the incorporators of a Brush Electric Light Company for Youngstown, O., with a capital stock of $35,000.

The Brush Electric Light Company have announced their intention of forming an extensive manufactory of electric lights and machinery at some point in Canada, probably Toronto or Montreal.

Clinton (Iowa) parties have been awarded a contract for furnishing five miles of six-inch pipe for the use of the Western Union Telegraph Company in running underground wires in Chicago.

The recent Philadelphia mill disaster invests the electric light with new interest as a possible starter of conflagrations. That is a branch of the question which has been rather overlooked hitherto.

The European, American, Canadian & Asiatic Cable Company have completed their financial arrangements, and an order has been given for the manufacture of two Atlantic cables immediately.

George H. Christy, representing the Brush Electric Company, of Cleveland, has brought suit in the United States Circuit Court against the Siemens-Anderson Steel Company for an infringement of plaintiff's rights. It is claimed that the infringement consists in using the Weston and Fuller lamps, which are constructed on the same principle as the Brush, the right to use copper-coated carbons being involved in this suit.

PARIS, Oct. 21.—Electric Exhibition prizes were awarded to-day. America has five of the highest distinctive diplomas of honor, awarded to the United States Signal Office, Smithsonian Institute, Edison, Graham and Bell, Edison's being the only one granted to any one for electric lighting. Gold medals were awarded to the Anglo-American Brush and United States Electric Lighting Company, and to Gray & Tawtor; silver medals to Dolbear, Eccard, Bailey & Buskas, Connelly Brothers, Electric Indicator Company, Hubbard Pond Indicator Company, the Electric Dynamic Company, Western Electric Light Company and Western Electric Manufacturing Company. Americans have also received several bronze medals.

The system of underground telegraph wires has been adopted in Philadelphia, and a company is busy digging trenches and laying tubes. A trench is dug in the middle of the street, three feet nine inches in depth. The bottom and sides of the trench are lined with concrete. The tubes, two inches in diameter, are then put in place, five in a row, and four rows, one above the other. A composition of pitch and slag is then poured in, until the pipes are covered, after which the top is cemented with concrete. The ditch is then filled in and the earth rammed down. It is calculated that the twenty tubes will accommodate from 1,000 to 1,500 wires. A manhole is placed in each square, and the wires will be forced through after the tubes are all laid. The work is mostly done at night.

The Herz system of telephony has excited special attention among electricians in Europe, on account of the surprising distances through which telephonic communication has been maintained by it, and especially since the announcement that a conversation had been carried on through the cable connecting Brest and Penzance—a thing generally considered impossible, on account of the comparatively sluggish action of the electric current in submerged cables. The Herz system—by which conversation, it is stated, has been carried on through an actual distance of over 600 miles over circuits having no special adaption to telephonic communication—claims to have solved two difficult problems, viz.: that of increasing the amplitude of electrical vibrations, and of neutralizing currents foreign to the telephonic circuit.

THE EDISON LIGHTS.—The annual meeting of the stockholders of the Edison Electric Light Company was held this week at the company's offices, in Fifth avenue near Fourteenth street. Of the 4,800 shares represented in the capital stock of $480,000 the number voted upon at the meeting was 3,267. The purpose of the meeting was the election of a Board of Trustees composed of 13 members, and the discussion and adoption of the annual report summarizing the transactions of the company for the last year. The report set forth, in opening, the manner in which the indebtedness of the company contracted during the year 1879 was liquidated by authorizing the Board of Trustees to borrow of

the stockholders a sum equal to 60 per cent. of their stock, and to issue in consideration of such loan certificates of indebtedness convertible at par into shares of the capital stock. In November, 1880, an increase of the capital stock from $300,000 to $480,000—the present figure—was duly sanctioned at a special meeting, and the certificates were redeemed by the issue of new shares. The exhibition of the electric light at Menlo Park last winter, which occupied two or three months, was next adverted to as having proved the practicability of the Edison system and demonstrated its economic success. Six hundred lamps were kept lighted for weeks and six miles of mains were laid in the streets of that village. In January last Mr. Edison announced that his system was perfected, and experiments were discontinued. The next step was to test the system on a large scale for street and house lighting and for this purpose a tract in New York City was selected. It was found, however, that the Edison Electric Light Company could not obtain leave to lay mains beneath the streets, and a new company, known as the Edison Electric Illuminating Company, had to be incorporated under the gas statutes of the State before the work of laying the mains could be commenced. This was done last spring, and contracts between the two companies were signed as a condition precedent to further action. In the same manner, in June last, it was resolved to form a special company for the development of the electric railway for whose exhibition Mr. Henry Villard is now building two and a half miles of road at Menlo Park, under a contract entered into in September last. The lighting of railway trains and steamships by electricity has not yet received the full attention of the company, and no new movements will be made in these directions until the completion of the station in this city and the lighting of the proposed district have been successfully accomplished. The steamships Columbia and City of Worcester are now lighted by the Edison system. The business of supplying isolated plant for dwellings and manufactories has developed rapidly under the superintendence of Mr. Moore. The Orange Woolen Mills, Newburg; the Baldwin Locomotive Works, Philadelphia; the factory of Hinds, Ketcham & Co., New York; the Prospect Park House, at the Adirondacks and the Newburg factories are among the establishments in which the system is in successful operation. Among the establishments to be lighted must be mentioned the residence of Mr. William H. Vanderbilt, the factory of Nathan Dreyfus, the shops of the United States Rolling Stock Company, Ohio; and the residence of Mr. J. Pierpont Morgan. The annual election resulted as follows: Norvin Green, Tracy R. Edson, James H. Banker, E. P. Fabbri, Nathan G. Miller, Robert L. Cutting, Jr.; G. P. Lowrey, J. F. De Navarro, Thomas A. Edison, Henry Villard, S. B. Eaton, E. D. Adams, F. W. Foote.

## STREETS, DRAINAGE, ETC.

Chicago week before last had 240 deaths, including 63 from diphtheria, typhoid fever and pneumonia, and 35 from small-pox, and an epidemic of zymotic diseases is apprehended.

Raleigh, N. C., is having more typhoid fever, diphtheria and other similar diseases than ever before in its history, and gross neglect of public sanitary matters is given as the cause.

The Mexican Chamber of Deputies has approved the contract made by the Executive for the establishment of a National Bank and the contract for draining the Valley of Mexico. The approval of the Senate is yet required.

The Hartford (Conn.) Common Council has resolved to have a much-needed sewer through the north meadows, which reek with filth and malaria in the warm seasons. It is proposed to assess property that is specially benefited for $6,000, and tax the city for the remaining cost, about $45,000.

The city of Northampton, Mass., has been agitating the question of sewerage for a year or more. Two systems, differing in cost about $200,000, have been discussed, and there is now some prospect of a compromise system being adopted. At a late meeting it was proposed to get estimates from competent engineers as to the cost of the smaller plan, with expert opinions as to the advisability of the town's adoption of this scheme.

The Springfield, O., City Council has taken up the matter of a system of sewers, and held a special meeting Thursday evening, the 20th, to fully consider it and take action. An elaborate plan was prepared two years ago by Earnshaw & Boch, sanitary engineers, of Cincinnati. Some members favor this plan, and others something more on the Waring system, as now in operation in Memphis and other cities. It is likely the work will be commenced next season.

The Department of Public Works, Chicago, opened bids, on the 20th, for large quantities of special castings and cast-iron water-pipe, to be used in the street improvements now in progress. The Union Foundry Works and J. H. Bass offered to supply the special castings for cast-iron water-pipe at $52 and $57 per ton respectively. For the hydrant and stop-valve castings the Union Foundry Works sent in a bid of $64 per ton and J. A. Bass $60 per ton. The following were the bidders for 1,000 tons of cast-iron water-pipe: Lake Shore Foundry, $43.50 per ton; A. H. McNeil, $43.95; Dennis Long & Co., $43.80; Cincinnati & Newport Company, $43.94; R. D. Wood & Co., $43.88. Schickle, Harrison & Co., $45.

CINCINNATI SEWERS.—Nearly a year ago the Board of Public Works directed the Chief Engineer, Stanley to report estimates for sewers in the east end of th city, with a view to remedy the down-pour of hillside sewerage above the intakes of the pumpng works on Front street. The estimates are as follows:

ESTIMATE NO. 1.

For sewers in East Front street, from Eggleston avenue to Kemper lane, and in Kemper lane, from East Front street to Francis lane, of sufficient capacity to drain the territory adjacent and that portion of Walnut Hills contemplated in plan of District No. 2, of Division No. 11, etc., recently adopted by the Board of Public Works.

| | |
|---|---|
| 3,600 feet 6-foot sewer at $12 | $43,200 |
| 800 feet 5-foot sewer at $10 | 8,000 |
| 1,600 feet 4-foot sewer at $8 | 12,800 |
| 20 manholes at $50 | 1,000 |
| 20 catch-basins at $75 | 1,500 |
| Castings, sheeting and inspecting | 2,500 |
| Total for East Front street sewer | $69,000 |
| 1,600 feet 3-foot sewer in Kemper lane at $6 | 9,600 |
| 5 manholes at $50 | 250 |
| 6 catch-basins at $75 | 450 |
| Castings, inspection, etc | 400 |
| Total for East Front street and Kemper lane | $79,700 |
| Of this amount, probably there could be collected by assessment | 20,000 |
| Leaving to be paid by the city a balance of | $59,700 |

ESTIMATE NO. 2.

Sewer in East Front street to Kemper lane of sufficient capacity and depth to be extended to East Corporation line, as provided in Estimate No. 3.

| | |
|---|---|
| 12-foot sewer in tunnel 6,000 feet at $80 | $480,000 |
| 12 manholes at $200 | 2,400 |
| Lateral connections and contingencies | 4,600 |
| Total | $487,000 |

No portion of this amount could be collected by assessment as a separate sewer would have to be laid to provide for local drainage on account of depth of main sewer.

ESTIMATE NO. 3.

Intercepting sewer from Eggleston avenue to East Corporation Line, and extension of Eggleston avenue sewer westward.

| | |
|---|---|
| 6,000 feet 12-foot sewer in tunnel at $80 | $480,000 |
| 6,000 feet 11-foot sewer in tunnel at $75 | 450,000 |
| 3,000 feet 10 foot sewer in tunnel at $70 | 210,000 |
| 5,000 feet 9¼-foot sewer in open cut at $30 | 150,000 |
| 5,000 feet 8¼-foot sewer in open cut at $25 | 125,000 |
| Crossing Crawfish Creek | 40,000 |
| 30 manholes at $200, and 20 manholes at $100 | 8,000 |
| Lateral connections and contingencies | 17,000 |
| Total | $1,480,000 |
| Extension of Eggleston avenue sewer westward—1,000 feet at $200 | 200,000 |
| Total for sewer and extension | $1,680,000 |

Estimate No. 3 is for a sewer of sufficient capacity to receive the drainage of the river slope from Eggleston avenue to the East Corporation line, the northern limit being the summit of the ridge extending from Gilbert avenue along McMillan street, Madison road, Grandin road, and summits north of Columbia and Undercliff avenue, but it does not provide for the area drained by Crawfish Creek (about 1,300 acres) within the city limits.

The right of way through private property for about 3,400 feet is not included in the estimate, as sufficient data for determining the cost of the same are wanting.

No part of the cost could be collected by assessment, as separate sewers, at less depth, would be required for local drainage.

These estimates have been forwarded to Council for its action.

## BRIDGES.

The Cook County (Ill.) Highway Commissioners of the various towns have certified that the following amounts are necessary for the repairs and building of the bridges in the county. The County Clerk will extend the amounts on the tax for 1881-82:

| | | | |
|---|---|---|---|
| Barrington | $400 | Norwood Park | .... |
| Bloom | 1,600 | New Trier | $800 |
| Bremen | 2,000 | Orland | 800 |
| Elk Grove | 950 | Palatine | 600 |
| Hanover | 300 | Palos | 300 |
| Lemont | 1,400 | Proviso .... 40c. on the | 100 |
| Leyden | 2,000 | Rich | 300 |
| Lyons | 500 | Schaumberg | .... |
| Maine | 500 | Thornton | 1,500 |
| Niles | 1,200 | Wheeling | 500 |

## RAILROADS.

The St. Louis & San Francisco are working to open up the shortest route to a very rich portion of Texas and the great Southwest.

The New York & New England Company intends, it is said, to secure a connection with New York City via Danbury, Litchfield and White Plains.

It looks as though a railroad would be built from the Adirondack road at Luzerne, N. Y., by way of Lake George to the Central Vermont at Addison Junction.

A surveying party has started to run a line from Fort Smith, with instructions to find a feasible route to the Red River, by keeping within the State of Arkansas.

The inventor of the Fontaine locomotive claims that the second one, just completed, will run 100 miles an hour without getting tired. It had not done so at last accounts.

The surveying staff of the Atlantic & Northwestern Railway are encamped at Herron Island, at the foot of the Lachine Rapids, making their surveys in the shallows.

The Canada Atlantic Railway Company expects to have its 108 miles of road from Ottawa to Montreal completed by July 1 next. They expect to have 31 miles in operation by Nov. 1.

A preliminary survey for the Winnipeg & Southwestern Railway from Winnipeg southeasterly to the international boundary, where it will connect with the Duluth & Winnipeg, will be commenced this week.

Engineer Polke and his party are within 12 miles of Shreveport, La., locating the line of the Vicksburg, Shreveport & Pacific Railway. Manager John Scott, of the Erlanger combination, is expected there daily to select a site for the bridge over Red River.

The Lake St. John Railway directors have found a pass 1,343 feet high through the Laurentides, the crossing heretofore preferred being 2,500 feet high. The land through which the road runs is not sterile as supposed. Around Lake St. John are 3,000,000 acres of wooded land nearly all fit for settlement.

A dispatch from Tucson, Ariz., dated Oct. 24, says: "The Texas & Pacific Railway's surveying party have applied for a military escort which has not yet been granted. The course of the survey leads them through the San Carlos Agency to Globe, and it is feared that the Indians may be suspicious of their movements and give trouble. Should they suspect it is an attempt to steal their lands they will probably attack the surveyors."

EVANSVILLE, Ind., Oct. 20.—An organization of the Evansville, Jackson & New Orleans Railway Company was effected in Henderson yesterday. R. G. Hervey, of the Evansville & Indianapolis Air Line, was elected President, and J. J. Morton Secretary and Treasurer. It is expected that the road, when built, will become a part of a trunk line in which the Evansville & Indianapolis straight line will be included.

Rails have been laid upon the Mexican Central road for 60 kilometers beyond Tula, which is 150 kilometers from Mexico. It is expected that the road will be completed to Irapirata, 351 kilometers, by the end of November, when there will be due from the government $2,375,000 in subsidies to the company. The Central Railroad recently made a contract in England and in Belgium for 90,000 tons of rails at a cost of $6,000,000.

SPRINGFIELD, Mass., Oct. 20.—The stockholders of the Tehuantepec Interoceanic Railroad, of which Edward Learned is President, met at Pittsfield yesterday and listened to a favorable report of progress. Forty miles of road will be completed from the northern terminus at Coatzacoalcos by December, and several miles are graded from the southwestern harbor at Chipequa, on the Pacific coast. The money provided amounts to $1,870,000, $1,539,282 being paid in.

Articles of incorporation of the Chicago Belt Line Railroad Company of Illinois and the Chicago Belt Line Railroad Company of Indiana have been filed in the office of the Illinois Secretary of State. The name of the new corporation thus created is the Chicago Belt Line Railroad Company, and its capital stock is $4,750,000. How many more "Belt lines" around Chicago are to be projected?

The latest intelligence from the Canada Pacific Railway parties is to the effect that the season's operations are drawing to a close. Mr. Marcus Smith is at New Westminster, where Mr. Gamsby, Mr. Wilmot, and their respective staffs will go to winter after completing their field work, as they were expected to do by Oct. 15. Mr. Keefer's party will winter at Victoria. Mr. Hamlin's party will remain in the field till near the end of November to complete their section.

The Live Oak, Tampa & Charlotte Harbor Railway Company, of Florida, has been incorporated. The main line will be about two hundred and sixty miles in length, and will be constructed between a point at or near Rowland Bluffs, in Suwannee County, to a point at or near, or on the waters of, Charlotte Harbor, in Manatee County, and pass through or into the counties of Suwannee, Alachua, Levy, Marion, Hernando, Hillsborough and Manatee. The incorporators are H. S. Haines, Wm. P. Hardee, John F. White, of Jacksonville, Fla.

The Leesburg & Indian River Railroad Company, of Florida, will be about 80 miles in length, and will be constructed from a point on the Tropical Florida Railroad nearly due west from Leesburg, in Sumpter County, thence east to Leesburg, touching the southern portion of Lake Griffin, the northern point of Lake Harris, thence to Lakes Eustice and Dora, passing through Orange and Brevard counties to a point at or near Titusville or Indian River, with branches to Lake Apopka and Lake Tohopkalaga, in Orange and Brevard counties. The incorporators are D. E. Maxwell, Frank B. Papy and E. W. Agnew.

For several months agents of the Atchison, Topeka & Santa Fe and the Atlantic & Pacific railroads have been quietly and cautiously negotiating for the purchase of property and the acquisition of right of way for terminal facilities on the San Francisco peninsula. They have now applied to the Board of Supervisors for a franchise to construct a single or double track standard gauge railroad, entering from the ocean beach side and extending to the city front both on the north and south. The petition has been referred to the Judiciary Committee. The petition comes in the name of the Ocean Shore Railroad, which is to run up the shore line from Santa Cruz.

There were in Prussia, in 1880, 640 foundries, partly connected with other works, which had a plant of 1,215 cupolas, of which 913 were in operation during the year; 114 reverberatory furnaces, of which 83 were working, and 194 other furnaces of different kinds, of which 148 were used. These consumed 123,618 tons of pig and 111,092 tons of scrap, broken castings, etc., of home manufacture, and 150,283 and 8,603 tons respectively, which were imported, a total of 393,596 tons. The principal items of production were 161,220 tons of machinery castings, 38,765 tons of hollow ware, 43,910 tons of pipe,

8,153 tons of chilled castings, and 104,767 tons miscellaneous castings, a total of 348,782 tons.

The Ohio Falls and Northwestern Narrow-gauge Railway Company has filed articles of association in the Secretary of State's office. The company proposes to build a road running from Ohio Falls northwest through Clark, Floyd, Washington, Orange, Martin, Daviess, Green, Clay, Parke, Fountain, Warren, Benton, Jasper, Newton, Porter and Lake counties, thence to Chicago. The total distance in Indiana is 320 miles. The capital stock is $6,000,000. The directors are Enoch Lockhart, W. H. Irwin, R. N. Barbour, Samuel Cleaver, Frank E. Clarkson, J. J. Brown, G. W. Gault, C. Barfield, J. T. Stout, Alexander Worrall and T. B. Buskirk, all of Louisville.

Major H. Wadsworth Clarke, C. E., of Syracuse, in charge of the boundary survey between Pennsylvania and New York, with a party of surveyors and assistants is monumenting about fifteen miles of the line. His headquarters are at Waverley, N. Y. At the same headquarters is another party in charge of Civil Engineer McComb. They have made a topographical survey of about eight miles of Chemung valley for the purpose of showing the true position of the tracks of the New York, Lackawanna & Western and Erie railways and riffles and riffle-bars, etc., of the river. The work has been done with great accuracy and minuteness, and is for the use of the commissioners who have under consideration the new railroad crossing near Waverley. Another surveying party in the interest of the Sodus Bay & State Line Railway were in Waverley last week.

The Elevated Roads.—The new arrangement by which the elevated railroad troubles are ended was fully and finally ratified by the three boards of directors on the 24th inst. President Cyrus W. Field, of the New York Company, dictated the following as the terms of agreement: "All the back interest on the bonds of both the Metropolitan and New York companies is to be paid in full, and the two past-due quarterly dividends of 2½ per cent. each on New York stock are to be paid. The past-due Metropolitan dividends are canceled. Stockholders of both companies will begin to receive dividends on Jan. 1 next, if earned. The dividend on New York is to be first paid and is to be cumulative—that is, if the combined earnings of the two roads under the Manhattan management should not reach 6 per cent. over and avove running expenses, repairs, rentals, taxes, interest on bonds, etc., New York stock will receive the difference out of the next year's earnings before the Metropolitan stock receives anything. Metropolitan dividends are not cumulative, and after the New York stockholders are paid the Metropolitan stockholders are to receive a like percentage. Whatever remains, if any, will go to the Manhattan stockholders." Mr. Field added that with careful management all the stockholders will get dividends. The claim of the New York Company for back interest and dividends amounts to $627,500.

At a meeting of the stockholders of the Evansville, Jackson & New Orleans Railroad, held at Henderson, Ky., on the 19th, the following gentlemen were elected directors: Hon. Wm. Fleming, Fort Wayne, Ind.; Chas. Viele, R. G. Hervey, Peter Maier, R. P. Hill, P. Semonin, G. L. Dixon, J. J. Kleiner, Evansville, Ind.; S. H. Cassidy, Dycusburg, Ky.; Hon. Charles Anderson, Kuttawa, Ky.; J. C. McElrath, Murray, Ky.; J. W. Blue, Marion, Ky.; R. L. Ellison, Paris, Tenn. The board of directors subsequently organized by the election of Mr. R. G Hervey, President and J. J. Morton, Treasurer.

Resolutions were unamiously adopted authorizing the president to make the necessary surveys, select the route, and do everything necessary, with a view to having the construction of the line pushed forward at the earliest practicable moment.

This project is virtually an extension of the Indianapolis & Evansville Railway into the southwest, and it is stated that the line proposed will make the shortest line in existence between the eastern trunk lines and the Southwest, the distance from Indianapolis to Memphis via the Indianapolis & Evansville Railway and the Evansville, Jackson & New Orleans Railroad being 186 miles shorter than by the shortest route now existing. This fact alone will make it one of the grandest roads in the country, and will insure it a large business. The project for this great through trunk line embraces also a bridge across the Ohio River at Evansville, for which the parties interested have a charter.

A New Trunk Railway Line.—A new railway, known as the Baltimore, Cincinnati & Western Central is to be constructed from Baltimore to Cincinnati, following a line as nearly direct as possible midway between the Baltimore & Ohio and Chespeake & Ohio roads, nearly parallel with the former and with a route which it is claimed is far superior to either in cost of construction, grades and local resources. The new line has enlisted the aid of some of the richest men and ablest railroad managers of New York, Cincinnati and other cities; they have been thoroughly convinced that it will prove a profitable enterprise. The project was originally started under the name of the Baltimore, Cincinnati & Western, but in December, 1880, charters were taken out in Maryland, West Virginia & Ohio under the present name. Since that date the work of organization, the final location of the line and the perfecting of the financial plan have been pushed vigorously, and now almost all the details preparatory to active work are perfected. Five routes were surveyed, that selected being briefly as follows: Starting from Cincinnati, the line follows the north bank of the Ohio River to Portsmouth, then to Gallipolis, on the Ohio River—a distance from Cincinnati of about 150 miles. Crossing the Ohio River there into West Virginia, the line follows the Great Kanawha River a distance of 54 miles to Charleston, where it connects with the Chesapeake & Ohio Railroad, coming up from Richmond. From Charleston the line turns northeasterly, and follows up the Valley of the Elk River for some 167 miles to its head waters at the Alleghany Mountains; crossing there through a remarkably low gap, upon a grade of only 73ft. to the mile, it passes a distance of about 9 miles to the north fork of the south branch of the Potomac River, and thence by the banks of same for some 60 miles to Moorefield, near the boundary of Virginia and West Virginia. Thence the line crosses the country, via Winchester and Leesburg, to the Potomac River, a distance of about 104 miles; and crossing that river at Edward's Ferry, it passes through the State of Maryland about 57 miles to the city of Baltimore. Thus the line extends a total distance of 601 miles from Baltimore to Cincinnati, of which distance 381 miles, nearly two-thirds the entire length, are along the banks of rivers, an advantage possessed by no other railroad of equal length in the United States, and securing to this road a very low cost of construction. A construction company has been formed under the laws of New Jersey to build and equip the road. It is called the Union Improvement Company, and will have a capital stock of $10,000,000. The railway company will deliver to the improvement company $25,000,000 of first-mortgage 6 per cent. bonds and $25,000,000 of common stock, in consideration of the construction and equipment of the railway by the improvement company. The improvement company will first receive subscriptions to its own capital stock of $10,000,000, and when all taken will call up installments on same as required and proceed at once with the construction of the road. The improvement company will then negotiate, through its bankers, the $25,000,000 of bonds received from the railway company, and when sold will use $10,000,000 of the money to reimburse the stockholders of the improvement company for that amount of cash paid in by them, and apply the remaining $15,000,000 to the completion and equipment of the road as per contract. This will leave the $25,000,000 of railway stock still in the hands of the improvement company, and when that is divided up among the holders of the $10,000,000 improvement company stock it will make a dividend to them in railway stock of two and one-half times the amount of their original investment; besides which they get back the whole amount of their original investment in cash from the sale of the bonds, as stated. The subscribers to the capital stock of the improvement company will therefore realize as follows:

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|---|---|---|
| Cash to be paid for improvement company stock | | $10,000,000 |
| First dividend in railway stock | $10,000,000 | |
| Second dividend in railway stock | 10,000,000 | |
| Third dividend in railway stock | 5,000,000 | |
| | $25,000,000 | |
| Final dividend in cash | $10,000,000 | |
| Making total dividends to stockholders in the improvement company, in railway stock and cash | | $35,000,000 |

## NEW PROJECTS.

The New York, Pittsburgh & Chicago Railway Company has established its principal office for Ohio at New Lisbon.

Articles of incorporation of the Dallas & Western Railroad Company have been filed in Austin, Tex., the incorporators being Texas and Pennsylvania men.

A charter was filed on the 24th for the organization of a Stock Yard Company in Topeka, with Ed. Herrins, a large shipper from Southwestern Kansas, Wm. Sims, and other prominent men, as directors. Capital stock, $100,000.

Agents of the Pennsylvania Railroad Company have been surveying between Woodbridge, N. J., and Port Richmond. It is said that a railroad it to be built between those points in connection with the Pennsylvania road.

The Duluth & Winnipeg Railway advertise for 30,000 ties and a large quantity of piles. Twenty miles from Duluth will be completed as soon as possible, and the road will be pushed to Winnipeg sooner than the public imagine.

Bannerman's survey party, with W. W. Kirkpatrick, C.E., as chief engineer, have returned from the exploring survey for the Winnipeg & Hudson Bay Railway. They found the Nelson River for 100 miles from the mouth navigable for sea-going vessels. From Limestone Falls, at this point, a line 310 miles was found practicable to Sea Falls, on the Sea River, near Norway House, at the head of Lake Winnipeg, and 330 miles by water stretches from Winnipeg, or a total distance of 640 miles from here to a seaport on the Nelson River.

The preliminary survey for a new railroad between New York and Springfield, Mass., under the supposed direction of Mr. Vanderbilt, is in progress; the surveyors have staked out a route the entire distance between New York and Springfield. North of New Haven the line hits Meriden remotely and touches Cheshire, but goes through only one flourishing place, New Britain, 10 miles from Hartford.

A meeting of the stockholders of the Cincinnati & Eastern Railway Company has been called for Saturday, Nov. 19, 1881, to vote upon certain propositions which have been submitted to them, and which are: 1. To increase the capital (common) stock of said company to two millions ($2,000,000) dollars. 2. To build a branch of said company's railway, starting from a point in the main line thereof near the Scioto River, in Scioto County, O., and running thence through Scioto, Jackson, Lawrence and Gallia counties, to a connection with the Ohio & West Virginia Railway, at or near Gallipolis, O.

## CONTRACTING, MISCELLANEOUS, ETC.

The steamship Great Eastern was sold at auction at London last week for $150,000.

Confederate bonds were selling at $4@5 per thousand in Wall street on Saturday.

Of the dozen tenders for the Post Elgin (Ont.) Harbor Improvements, opened on the 21st, that of Mr. Sutton, of Brantford, for $19,000, was the lowest.

There are 10,000,000 bushels of coal loaded at Pittsburg awaiting a rise. The mines were put in excellent order during the recent drouth and an immense production this fall is expected.

It is believed that at last the engineers have mastered the quicksand formation in the St. Gothard Tunnel under Adermatt by means of granite vaulting, and that the great work will be finished next month.

The Cooper Manufacturing Company, of Cincinnati, O., have been awarded a government contract for seven iron lighthouses, to be erected on the southern Atlantic coast and Savannah River and harbor.

The cost of placing a year's cotton crop in the New England market, including ginning and baling, is estimated at $108,600,000, of which $30,000,000 goes for freight and insurance while en route.

The contract for the building of the trestle, 25 miles long, across Lake Ponchartrain, and approaches, has been awarded to Messrs. Fletcher, Warsenberg & Co., of Chattanooga, at a cost of over $1,25),000. It is the largest timber contract ever given in the South.

The iron business is steadily improving. Higher prices are asked and paid for finished iron, though rails are stationary because the tariff gives importers an advantage on them over some other manufacturers. Rolling mills are finishing the cheap summer contracts. Steel rail mills are full of next year's work, and quoted at $60. Activity in railroad business in Europe interferes with importation to this country.

The growth of Winnipeg is unprecedented. During the past summer the sum of $2,225,000 has been expended in the construction of houses, which are principally of the veneer style, and in many cases several stories in height. A law has been enacted, soon to come into force, for the prevention of the construction of such buildings whose height exceeded a story and a half. Laborers command the very best wages. Bricklayers and masons earn from $6 to $7 per day, and carpenters somewhat less. By next month the Manitoba Southwestern will be running and fully equipped for fifty miles.

The Phœnix Iron Company, Phœnixville, has just succeeded in rolling a bar of what is known as "1⅛-in. guide rounds," which, after the crop ends had been taken off and trimmed ready for the market, measured 65 ft. 5 in. This is the largest bar of that diameter ever rolled in any mill in the world. The new 18-in. train, three high, are being made for the company's new mill at Phœnixville. It will take several months to complete them. When erected there will be four roll trains running. An additional gas producer will be built, plans for which have already been made.—*Iron Age.*

The Ottawa (Ont.) *Free Press* says: "It is understood that the government has decided to construct a more direct line of railway from Yale to Port Moody, in British Columbia, than that by way of New Westminster. The distance is 110 miles. It is proposed to have the work under contract by Jan. 1."

One reason why the rains in the North have been so peculiarly damaging to the crops is the manner in which they are cared for. Storage in barns is almost unknown. Threshing is done in the open field, and when a storm comes on it receives but the inadequate protection of careless stacking. More experience of this kind may change the customs of the country somewhat in these respects.

According to an English geographical writer, there are four vast areas still to be opened up or traversed by civilized man, and which, among them, constitute about one-seventeenth of the whole area of the globe. Of these, there is the antarctic region, which in extent is about seventy-five times that of Great Britain; the second lies about the north pole; the third is in Central Africa, and the fourth in Western Australia. The south polar region referred to is almost conterminous with the antarctic circle. The vast African area reaches on the west very closely to the coast, and it is only near the equator that it has more than superficially been driven inland. In Australia, the great undeveloped region is that which lies west of the track explored from north to south by Stuart, and which now forms the line of telegraphic communication across that continent.

The Cost of Ties.—Just now there is coming into the city of Pittsburgh over the P. & W. road some fine specimens of white oak railroad ties. They come from portions of Butler, Beaver and Lawrence counties, just reached by the tie hunter. A gentleman engaged in supplying these to the railways, answered an inquiry as follows: "Why," said he, "in laying a mile of new track we use 2,800 ties, costing on the track about 65 cents each, or $1,820 to a mile. These ties last on an average eight years, it being necessary to replace one-eighth of the old ties on the road with each new year. Hence you see the bill for ties must of necessity be a large one."

When the gauge is widened on this road, all the spike holes must be plugged up, to keep water from decaying the ties.